THE COMPUTER BULLETIN

VOLUME FIVE

JUNE 1961–MAY 1962

INDEX

5-6

A

B

C

J

K

L

M

N

O

P

R

S

T

U

W

X

Z

THE SYMPOSIUM ON ELECTRONIC DATA PROCESSING

At this year's Electronic Computer Exhibition and Electronic Data Processing Symposium the message is one of technical advances and user experience and the audience will be composed of a much wider range of businessmen and scientists than have hitherto interested themselves in the use of the computer.

The following programme of the Symposium and a short summary of most of the papers are given for the information of members of the Society. They were corrected up to the time of going to press, but may still be subject to slight amendment. Further details will be given in *The Computer Bulletin* for September, which will also contain a preview of the Electronic Computer Exhibition.

Provisional Programme and Synopses of Papers

SESSION 1—1958–1961 A RECORD OF PROGRESS

"Government Experience," J. D. W. JANES (*H.M. Treasury*).

"Production Control Scheme for Letchworth Factory," J. GRANT (*International Computers and Tabulators Ltd.*).

Introduction. Outline of system and objectives—intended time scale of introduction.

Phase I. Implementation in "pilot" factory—preparation entailed—standard data validation—assessment of stock and work in progress at changeover date—propagation of purpose and mechanics of completely new control system—training of various levels of Management.

Phase II. Revision period—some systems redesign—further editing of standard data—more intensified training in purpose and objectives—revision of periodicities of some of the reporting stages.

Phase III. Reconsideration of systems in departments contiguous to production control—design change—works study—jig and tool design—inter-factory ordering. Reviews of form and design flow.

Phase IV. Planning and preparing for introduction of complete scheme into three other major factory organisations.

Conclusion. Summary of results and economic advantages—impact on various levels of Management—ideas for future development.

"Inventory Control, Accounting and Payroll," A. BRADLEY (*Ford Motor Co. Ltd.*).

The paper reviews successful progress made with the subjects discussed in the 1958 report, attention being drawn to the problems that have been met.

1. Invoicing and inventory control of spare parts on a LEO computer since early 1959, involving 30,000 line items daily—the problems of getting the job operational—the flexibility of the computer in coping with unexpected demands.
2. Payroll of 30,000 employees now being transferred from a service basis to a company-owned LEO computer.
3. Development of plans for mechanising on a LEO computer the control of production material requirements and stocks, for the assembly of motor vehicles and tractors.

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SESSION 2—1958–1961 A RECORD OF PROGRESS

"Establishing Electronic Data Processing at the Trygg-Fylgia Insurance Companies, Stockholm," K.E. SCHANG (*Trygg-Fylgia Insurance Co's Group, Sweden*).

After one year of operation of our Ferranti PERSEUS computer, we can make the following statements:

(*a*) Since October, 1960, the savings correspond to a revenue of 20% on the total investment for the automation system—a most heartening figure, which is expected to be significantly improved during 1961.

(*b*) Although one million policies are now handled by the computer, conversion has been slower than was foreseen, and the incorporation of all the programs of the four integrated plans will require at least another year.

(*c*) Organisational changes, especially in the life insurance departments, have been considerable; but these have been manageable without great difficulty because the introduction of automation has been a slow process.

(*d*) Personnel reaction towards automation has been studied by a group of scientists—the preliminary results are not surprising: "Information is essential."

"3½ years practical experience," N. C. POLLOCK (*Stewarts and Lloyds Ltd.*).

The paper shows the progress to achievement of the programme of work described at the Symposium in December 1958 on the LEO II computer at Stewarts and Lloyds Ltd., Corby. It shows that this work has nearly been completed and that other tasks, not mentioned at that time, have been successfully attempted. The paper also discusses some mistakes which were made, some lessons learned and the general conclusions we have come to from three and a half years practical experience. Finally the paper refers to recent work on a more ambitious and more integrated job of data processing now under detailed investigation.

"Invoicing," A. J. BROCKBANK (*Glaxo Laboratories Ltd.*).

"Production Control by Hiring Computer Time," R. B. BAGGETT (*Job White and Sons Ltd.*).

1. The Production and Stock Control application is being maintained broadly on the original lines. Some modifications have been made from experience and also due to the greater facilities of the DEUCE Mk 11A. Material usage control has been tightened.
2. Analysis and pre-planning of production, material, and labour requirements has been introduced.
3. A method of forecasting sales has been established and verified, enabling production to continue in anticipation of orders at the beginning of a new season.
4. Cost recovery checks and accounting programmes are being introduced.

5. An investigation of machine loading by computer is being done. Also an investigation into the preparation of input data for pieceworkers' wages.
6. Steps are being taken towards integrating the various programs.

SESSION 3—DATA PROCESSING IN INDUSTRY AND COMMERCE

"Stock Control," R. T. EDISON (*Navy, Army and Air Force Institutes—NAAFI*).

"Provisioning 1,300 Shops," D. S. GREENSMITH (*Boots Pure Drug Co. Ltd.*).

"Data Processing in Commerce," L. G. BONNEY (*Crosse and Blackwell Ltd.*).

The paper will be divided into four main sections:

1. What is data processing?—being a short general description, concluding with particular examples for discussion under later headings.
2. Why a Computer?—giving a brief analysis of the advantages of EDP over manual and mechanical methods of processing.
3. The practical approach to installation of EDP—covering the original survey of the particular problem; choice of computer, selection of suitable staff, operation of feasibility survey, the determination of the strategy to be adopted and the preparation of an operation schedule.
4. Results of our own EDP project—giving details of the planned applications with reasons for selection and the results to date.

"Use of a Computer in Banking," J. LETHAM (*Bank of Scotland*).

Aim—to centralise in a computer installation the millions of book entries presently made at Branches widespread throughout the country and maintain the service customers require.

Benefit—elimination of expensive ledger posting equipment and of operating staff at Branches.

New procedures involved—(1) Programming computer to record credits and cheques on thousands of banking accounts; calculation of interest, frequently at several rates; aggregation of data for changes, etc. (2) Data transmission involving paper tape production; telex; direct telegraph line; telephone line.

Approach—Gradual build-up because of variety of customers and incidence of turnover of work at Branches; IBM 420: 421 and finally 1401.

Establishment—alignment of data input; details of transactions; recording and filing; output printing; other work done.

"Using a Computer for Insurance Work," F. C. KNIGHT (*Commercial Union Assurance Co. Ltd.*).

The Commercial Group of Insurance Companies are to use a KDP 10 computer with 10 magnetic tape stations to handle its 5 million U.K. policies.

Each branch office will transmit data daily by GPO wire to the Computer Centre, using punched paper tape.

The Computer Centre will check, edit, and process the data, printing policies, endorsements, renewal documents and accounts—the complete range needed to operate the Companies.

In addition the Computer will handle all statistical matters, and office housekeeping jobs, including Dividend work and staff salaries.

All printing at the Computer Centre is by Xerography.

SESSION 4—DATA PROCESSING IN INDUSTRY AND COMMERCE

"An approach to Integrated Production Control," W. J. KEASE (*A.E.I. Hotpoint Ltd.*).

The paper will be divided into three parts. The first will consist of an outline of the basic situation to be controlled and indicate the factors which led to the choice of the computer subsequently employed.

The second part of the paper will discuss the way in which the proposed system was developed and deal in particular with the factors relating to inventory control and plant loading which were taken into consideration.

The third and last section of the paper will report on progress made during the implementation stages and summarise the benefits gained to date.

"Finished Stock Control, Production Monitoring, Sales, Statistics, etc.," F. STUBBS (*A.E.I. Lamp and Lighting Co. Ltd.*).

Following the decision to install a large Electronic Data Processing Unit for the Rugby Group of A.E.I. Ltd. it was agreed that after extensive surveys of various routines, the initial applications would be Finished Stock Control, Production Monitoring, Sales Statistics, Sales Invoicing and Sales Accounting for the lamp business of A.E.I. Lamp and Lighting Co. Ltd.

In addition to a priced product file, there is a customers file—both maintained on magnetic tape.

The input to the Computer is by paper tape, this being a by-product of Accounting Machines used for the production of unpriced Advice Notes.

"Sales," Speaker to be announced (*Shell International Chemical Co. Ltd.*).

"Recording and Controlling Production Stocks," D. O. BELL (*Standard-Triumph International Ltd.*).

The subject of the paper is an integrated system to record and control production stocks. The system is divided broadly into two parts: firstly, a suite of programs and usage records which enable individually specified motor cars to be analysed into a full list of the parts contained in them: secondly, the main stock control programs which, using the results of the first suite and a central stock record, provides information for financial, costing, stock control and supply scheduling purposes.

"Production Planning," J. ANTILL (*Rubery, Owen and Co. Ltd.*).

The introduction to the Paper will "set the scene" in describing the company, its size, characteristics and problems, with a statement of its fundamental objectives. A short history of our own office mechanisation will follow, showing the immediate objectives, and considerations affecting the choice of a particular Computer.

The main part will be devoted to an explanation of the total computer plan, with a specific and detailed treatment of one problem area in Production Control, i.e. Product

Explosion and Production Scheduling touching upon some advanced techniques which are being studied.

In concluding, attention will be drawn to the organisational and human problems. The phasing of implementation will then be discussed, together with an examination of the economics involved in the whole process. Final remarks will be devoted to a study of the attitude of top management, and the probable impact upon the organisational structure.

SESSION 5—Buying Time

Pointing the way for the small user

"Survey of the Computer Bureaux Services," D. W. Hooper (*The British Computer Society Ltd.*).

"Structural Stress Calculations," Dr. C. P. Wroth (*G. Maunsell and Partners*).

"Costing Oil Drilling Operations," Mr. De Verteuil (*Schlumberger Overseas S.A.*).

This firm has about 60 operating units scattered over 22 countries in the Middle and Far East. Clerical staff is virtually unobtainable at many of these isolated sites and in any case would probably be uneconomic to employ. Therefore they have devised a simple system of field reports which can be produced by the engineers and sent to the accounting office in London.

These reports are essentially lists of cash receipts and expenditures, and such items are entered in the ledgers on electric accounting machines wired to paper tape punches, abstractions being done automatically during the trial balance listing.

The tapes are sent to The National Cash Register Company's bureau in London and are then fed into a computer and stored in a magnetic disc memory unit. After checking, they are transferred to a magnetic film "file." During the actual processing run, the contents of this file are combined with the contents of another file containing the previous month's year-to-date figures.

At the same time the results of the computer's calculations are written on a third magnetic film, used to control a line-at-a-time printer which prints profit and loss and balance sheet reports for the operating units, the divisions and the entire organisations.

The final stage of processing is the reallocation of such expense items as research, engineering and head-office administration, the computer simultaneously checking that all accounts remain in balance. After this the printed reports are sent to Schlumberger's London Office, which distributes them to the field units.

Monthly reports are now received by Schlumberger within 48 hours of the tapes arriving at the bureaux.

"Planned Stock Control," C. H. Bayliss (*The Ever Ready Co. (Great Britain) Ltd.*).

"Keeping an inventory of Precious Metals," S. A. Emery (*Engelhard Industries Ltd.*).

Our stock records consist of the detailed accounts of some thousands of alloys in about forty separate locations. By far the most valuable constituents in these alloys are the precious metals comprising eight in all, and our accounting and statistical system is based on the recorded purchases, sales, wastage and distribution of these metals.

Our alloy accounts are kept in troy ounces to three places of decimals. Punched cards are used and monthly tabulations are produced setting out the movements of each of the alloys within each separate stock location. In order, however, to account for the movements of the basic fine metals it was necessary to break down each of the weights listed by reference to a formula book in which the percentage composition of the alloys is recorded. In practice some twenty thousand calculations had to be performed each month, and the answers written down under their correct headings in two or more columns on an analysis sheet on which there is a column provided for each precious metal, and an additional one for the base metal constituent. This last column is introduced merely to complete the cross cast, and so to provide a check on the arithmetical accuracy of the breakdown. Arithmetical accuracy is not enough, however, as wrong formulae can be read off, and amounts entered in the wrong columns, with the consequent bedevilment of the resulting totals.

The method employed achieved its main objective, which was to maintain integrated control accounts for each of the precious metals for every stock location and for the organisation as a whole: but the process was laborious. Two comptometer operators took two or more weeks to complete the breakdowns, and many hours were spent, often by senior staff, in locating errors in order that the correct final balance could be obtained. Stock reports were often so late in arriving as to be of little practical value.

It was decided to carry out the multiplying operations on the IBM 650 Computer.

A set of formula cards was prepared on which were punched the alloy code number and the corresponding percentage breakdown.

At the end of the month all the punched cards representing the alloy ledger transactions for that month with the opening balances on each account are taken to the Service Bureau, sorted to alloy code number order and collated with a duplicate set of formula cards which the Service Bureau keeps.

The formulae are then gang-punched into the ledger cards, after which the formula cards are removed from the pack, ready to be used again on the following month's operations.

The ledger cards are next sorted into departments and processed by the computer which takes just over two hours. The resulting schedules, which are printed straight out in a single run, make up a complete set of departmental control accounts, correct in every particular, and giving all the necessary information for incorporation in the published stock reports.

An operation which had previously taken from two to three weeks, is now completed regularly within three days, and a satisfactory monthly time-table can now be maintained.

"Evaluation of Secret Materials," H. A. Stevenson (*Stevenson and Howell Ltd.*).

Stevenson and Howell Ltd., London, manufacture and sell to the beverage and food trade a very wide range of essences, fruit juice compounds, edible colours, etc. In order to determine the value of stock-in-trade each year it is necessary to recost each manufactured item on the basis of raw material prices, either at cost or at current market value at the end of the financial year. This involves many thousands of calculations, which hitherto have had to be done by senior personnel, since the recipes, on which the goodwill of the company rests, are closely guarded secrets.

Speed has been essential in performing this task since the final accounts cannot be completed until the stock has been

evaluated, but it has often taken three or four months. Furthermore, to speed up the work various approximations have to be made with never enough time for a proper check on accuracy.

The writer visited the 1958 Electronic Computer Exhibition and was surprised to hear from a representative of the English Electric London Computing Service that the whole job could be done in under half an hour at a cost of some £15, and that it would be perfectly possible to maintain secrecy by using code numbers, to conceal the identity of the substances.

The data for the computer consists of about 500 raw material code numbers with the unit cost of each and about 2,000 product code numbers with their recipes in code form. Products containing anything up to 20 different ingredients with an average of five or six, these ingredients being either raw materials or other products earlier in the series.

The data are passed to the Computing Service within a few days of the end of the Company's financial year, and the corresponding evaluations, again identified by code numbers, are returned typed automatically to the company within a day or so. The saving in time in evaluating the stock is therefore a matter of months; furthermore, senior personnel no longer have to waste many hours in tedious arithmetic. The method is so quick and cheap that a run can be put through at other times of the year, if cost data is required for other purposes.

"A Market Survey," H. Wormald (*Midlands Electricity Board*).

In 1955 we carried out a sample survey of our domestic consumers to obtain information useful in the fields of selling, development and tariffs. The sample of 12,000 domestic premises selected for this purpose has since been continuously maintained by adding a proportion of new premises and subtracting demolished and converted premises. The second survey of this "permanent" sample was carried out in 1960 and it is intended to take further surveys at intervals of five years.

In the first part of the current 1960 survey a data sheet was completed for each of the consumers occupying the premises in the sample. There are 60 items on the data sheet, the first 11 dealing with general information about the house and household and the remaining 49 with appliances used for space-heating, cooking, water-heating and miscellaneous purposes. All but a few of these 49 items are concerned with the possession or non-possession of an appliance, or possession by the appliance of certain attributes; they can be verified by inspection of the appliance concerned. The remainder seek the information about the habits of consumers.

The second part of the survey, which will follow six months after the first part, is the recording for each consumer of the details of his electricity consumption for the preceding year and the corresponding revenue.

Analysis of the data collected is likewise in two parts; first, an analysis showing the proportion of consumers possessing given appliances and the proportion of given appliances having certain characteristics, along with, where appropriate, averages and frequency distributions; secondly, a somewhat more complicated analysis of consumption and revenue in relation to the number of assessable rooms, primary and secondary consumption blocks, groups of consumers possessing given appliances, etc. Both parts of the analysis are required for the total area of the Board and, to a large extent, for the seven administrative Areas into which the Board's area is divided, but the first part is also required for each of the 36 Districts.

The work of processing the data of the current survey is being done for us by the Midland Regional Service Bureau of International Computers & Tabulators Limited on their Type 1202 computer. The field work was completed in October and November, 1960, and the first results made available to us by the middle of March 1961.

"Brains Trust," Chairman D. W. Hooper (*The British Computer Society Ltd.*).

Session 6—New Techniques

"Data Communication," F. J. M. Laver (*G.P.O.*)

"New Techniques," Dr. A. S. Douglas (*C.E.I.R. (U.K.) Ltd.*).

"The Place of the Programmer," Dr. S. Gill (*The British Computer Society Ltd.*).

Programming was originally well-defined as being the preparation of instructions to cause a given machine to do a given job. Now the subject has spread and involves work that is sometimes intimately associated with machine design and not always with particular jobs. In general it is the task of specifying the performance of one system in terms of another. Many systems are considered, from handfuls of circuit packages to vast computer installations handling several complex problems automatically.

In the last few years, schemes have appeared that throw off many of the earlier shackles and allow programmers to think in terms of more powerful concepts. The intelligent machine is already on the horizon and when it arrives it will be more than a scientific curiosity.

"Character Recognition," Dr. M. B. Clowes and J. R. Parks (*National Physical Laboratory*).

1. Brief discussion of the role of ACR in data processing, with indication of the sort of difficulties encountered.
2. An outline, with examples, of the range of systems employed in automatic processing of alpha-numeric data. This would include parallel-code techniques; special type styles; "on-line" recognition of handwritten characters (Bell Laboratories work); general purpose systems. An indication of the limitations of each system, and an appraisal of the role of magnetic and fluorescent inks in CR.
3. An attempt to formulate some criteria by which industry could select the most appropriate techniques for the particular problem.
4. Some speculation about future trends and future needs.

COMPUTER COMMENT

$5 *Million Annual Savings Expected*

A USA Navy-devised system using computers to analyse the bids of companies competing to sell jet fuel to the Department of Defense is expected to save $5 million of the annual $400 million cost of the fuel. The new automatic data processing system took less than a day to process bids to the Military Petroleum Supply Agency for six months' supply of jet fuel, two billion gallons, costing about $200 million. These contracts will be announced this week. MPSA is the single manager under Navy direction for procurement, distribution and standardisation of petroleum products for the Department of Defense.

Developed by mathematicians and operations research analysts of the Navy Management Office and MPSA, the system represents a breakthrough in the solution of management problems of this magnitude with use of modern mathematics. A high-speed digital computer is given a giant puzzle involving over 500 complex interrelated bids from 95 oil companies. It also considers the needs of 300 military users, legal restrictions, physical conditions, and the shipping routes from each bidder to each destination which the computer must, itself, find and evaluate from an almost infinite number of possibilities.

The puzzle has so many possible solutions that mathematics are required to find the cheapest solution, even with the fastest computers. Yet, the small amount of data fed into the machine and the solution obtained are in non-technical, non-mathematical terms. Without human intervention, the system performs over 500 million calculations and produces a procurement and distribution plan which is the cheapest possible to the Government.

The computer used in the March awards, having generated and solved a set of mathematical equations, printed out reports which showed the awards to be made, the base to which each batch of fuel is to be shipped and the exact shipping routes, including all transfer points and methods of shipment. Before the new system was put into use, it underwent extensive tests which disclosed that savings of one and one-quarter per cent over the traditional methods of analysing bids would be made in the cost of procurement and transportation of fuel. The fact that the percentage of savings was not greater is a tribute to the methods previously used by MPSA, but since MPSA now procures over 400 million dollars' worth of jet fuel alone each year, the one and one-quarter per cent savings, amounting to 5 million dollars a year, demonstrate the results that can be obtained by applying mathematics to large-scale management problems.

Tunneltron

New advances in the investigation of tunnelling between superconductors were announced in papers given by Dr. Sidney Shapiro and Paul H. Smith, of *Arthur D. Little Inc.*, Cambridge, Massachusetts, on the opening day of the American Physical Society meeting in Monterey, California, 20–23 March. The use of new materials and the development of new detailed calculations reported to the meeting constitute the next important step forward in this interesting new development.

First announcement of the discovery of the "tunneltron," a negative resistance circuit element formed by placing an insulating film less than one-millionth of an inch thick between strips of two superconducting metals, was made by ADL scientists Dr. James Nicol, Dr. S. Shapiro, and Mr. P. H. Smith in October 1960. Since then, the effect has been demonstrated with a variety of metals and with different insulating films. The discovery has proved to be a powerful tool in low temperature research and shows promise of leading to a variety of very small and inexpensive circuit elements.

The negative resistance effect came to light in the original ADL discovery when the electron tunnelling current was measured between superconducting lead and aluminum. At that time the insulating film between the metals was provided by oxidation of the aluminum. Since then, other films, such as barium stearate, have been developed that are independent of the metals so that the effect can be demonstrated between any two superconductors. The most recent research at ADL has involved substitution of tin and indium for aluminum.

The new, detailed calculations of the theory of the effect were made by Dr. Shapiro and Peter F. Strong. They provide excellent agreement with the earlier experiments and with the most recent experimental results on Pb-Sn and Pb-In pairs reported by Paul Smith and Dr. John L. Miles. The calculations also agree closely with the predictions of the theory of superconductivity proposed in 1957 by Bardeen, Cooper and Schrieffer.

The small size of the tunneltron and the simplicity of its assembly by vacuum metal evaporation make it a promising candidate for future applications in cryogenic circuitry. Coupled with ADL's cryotron, it appears likely to play an important part in the development of ultra-small, fast, and inexpensive low temperature components for application in ultra-sensitive amplifiers and computers.

Mechanisms of Intelligence

Dr. Allen Newell of the Carnegie Institute of Technology and the Rand Corporation, USA, delivered three lectures to an audience of about one hundred people at the Institute of Archaeology, London, on 25, 26 and 27 April. He was introduced by Dr. R. A. Buckingham, Director of the University of London Computer Unit which had arranged the lectures.

The subject of the lectures had been announced as "The Heuristic Approach to the use of Computers," but Dr. Newell began by explaining that the subject could better be described as "Mechanisms of Intelligence." He quickly mentioned the many approaches to the subjects of human psychology and artificial intelligence, and said that his interest lay chiefly in the programming of computers to perform symbol manipulation and in the structure of problem solving procedures in both machines and people. As examples of problems he had used chess, draughts and the

proving of theorems. His interest lay in those problems which humans were able to solve, but unable to construct algorithms for their solution. He explained that he was really speaking on behalf of himself and his colleagues, Dr. Simon and Dr. Shaw, and also many others at Carnegie Institute and the Rand Corporation, who had contributed to this work.

Dr. Newell then stated the fundamental problem underlying all those to which he had given his attention, which he called "the combinatorial problem." Given a set of objects, and a set of operators which produce transformations of one object into another, the problem consists of finding a sequence of these operators possessing certain properties, e.g. resulting in one particular object or class of objects. Thus in chess the objects would be the various possible states of the board and the operators would be permissible moves.

If all possible sequences of operators can be examined the problem resolves to a simple and obvious process of selection. What makes the problem difficult is the fact that often the number of sequences to be examined is so enormous that a complete enumeration would be quite beyond any technique that could be employed within the confines of the universe. In chess, for example, it had been estimated that the number of different games was of the order of 10^{120}.

There is no simple way out of this difficulty, and in the work which Dr. Newell described there were a number of stratagems which had been used in combination to pick out sequences of operators which were more likely to yield success than others, thus narrowing the search. These stratagems had been called "heuristics" and the application of them had come to be called "heuristic programming." Dr. Newell emphasised, however, that the use of heuristics in no way removed the exponential build-up of cases to be examined in a large problem, but merely reduced the number somewhat. As the problem size increased it was still necessary to use more and more stratagems and faster computers to achieve success.

As an appendix to his first lecture Dr. Newell worked through a chess game that had taken place between a human chess player and a computer programmed in the way which he had described. The program, however, did not contain enough heuristics and finally lost.

His second talk was devoted to a comparison of the performance of a computer program (the "general problem solver") and a human subject in a particular situation, namely attempting to prove a theorem in mathematical logic. The program, which consisted of several thousand instructions, proceeded by constructing a series of "goals" and attempting to attain these, perhaps by first attaining a series of "sub-goals." These goals were printed out as they were formulated, and so provided a record of the machine's activity.

The human subject was given the same problem and asked to talk continuously as he attempted to solve it. In the example which Dr. Newell described there was very close correspondence between this and the machine record. There were, however, some significant differences which pointed to possible modifications to the program.

Since the program was merely a description of the way in which the machine progressed from one memory state to another it could be regarded as a theory of human behaviour, and the comparison between the computer and the human could be regarded as testing the validity of this theory.

In his final talk Dr. Newell talked about some of the characteristics of programs that operate on data having list structures, as exemplified by the programs for interpreting "IPL" (Information Processing Language) in which the "general problem solver" had been written. There were now several list processing languages being used in the United States, including LISP, FLPL, COMIT and the threaded list language by Perlis. In addition there were a number of programs which used list structures without having an explicit language for them.

Lists provide a simple solution to a difficult class of problems that arise in some types of program, but there are still a few residual difficulties when dealing with list structures. These include the problem of organising the re-use of storage cells that have become available, and the searching of lists to find particular features.

On the other hand, provision for handling list structures provides, free of charge, some valuable facilities for program organisation, in particular a ready means of taking care of subroutine linkages. The general problem solver in fact comprised some three hundred short subroutines.

List structures had already been used in some important practical problems, in particular one concerned with assembly line balancing.

One of the most important refinements of the list structure technique had been the invention of description lists, which enabled attributes of objects to be quoted in arbitrary sequence.

The last lecture was followed by a small discussion meeting at the Computer Unit at which Dr. Cooper described an interpretive program which enabled IPL to be accepted by the MERCURY computer. Dr. Cooper also described a program, which had been written in IPL and run on MERCURY, for the formal differentiation of simple algebraic expressions. Dr. Newell gave more details about IPL interpreters that had been written in the USA, and about programs that had used them. The meeting ended with a general discussion about where future improvements in programming languages might lie.

World Airline Route Book

One of the most important books in the airline industry is a 420-page volume written entirely by an electronic data processing machine. Published by the International Air Transport Association, it is a route book used for computation of fares between 70,000 pairs of airports in the world air network.

It represents the culmination of almost three years of preparatory work by a special IATA Computer Working Group and is the first substantial step toward the possible eventual computation of all fares and rates by electronic means.

The *IATA Mileage Manual* gives airlines the shortest operated distances between selected pairs of 1,600 cities on the world airline map. While an almost infinite variety of routings between these points is possible, the lowest fares to be charged are controlled by the most direct routing, with certain allowable deviations for the actual itinerary. The *Manual* will now be the authoritative statement of these routings.

Preparation of the new *Manual* involved over 800,000,000 mileage calculations. If done by hand, the job would have required 1,000,000 man hours of computation, or a year's employment for 5,000 men.

As produced by electronic computer, the *Manual* has been

turned out entirely by machine. Non-stop sectors flown by individual airlines were fed into an IBM 704 computer on magnetic tape. The machine then calculated the various combinations possible, selected the shortest routing applicable between each pair of points concerned, chose four intermediate points to indicate the routing and printed the result automatically on lithographic master pages.

While 36 months were needed to organise the project and prepare the data for the computer, final computation and production of the 420 master pages took only 30 hours. To calculate all reasonable routings from any one city in the tables to all the rest and select the shortest operated mileages takes 12 seconds.

The new *Manual* has revealed the fact that there are now more than 4,000 non-stop flight sectors operated by IATA airlines and other air carriers. The longest listed is 4,692 miles, between Anchorage and Paris; the shortest, 13 miles between Kamalpur and Khowai in India.

According to J. E. McGuire, *Pan American World Airways*, Chairman of the 11-man IATA Computer Group, the new *Manual* has additional significance as the airline industry's first co-operative effort to produce the raw material for routing.

With the blessing of the IATA Traffic Conferences, the Group is now evaluating a Model Trial Fares Table based on routings via the mid-Atlantic, which it is hoped will be the pilot project for possible world-wide electronic fare tables.

Actual calculation of the mileages was carried out on IATA's behalf by the industrial research firm of *Arthur D. Little, Inc.*, Cambridge, Mass., under the direction of Dr. Arthur A. Brown. A trial first edition was issued for Conference review.

Describing the complexity of the job, Dr. Brown pointed out that the number of all reasonably possible routings between the 1,600 cities concerned "is so large that you couldn't write it down within the solar system." However, the research team found a way to make the computer take the best routing choice at each stop, and so reduced the job to manageable proportions.

Information now contained in the *Manual* is stored away on 10,000 feet of magnetic tape which can be re-run for additional computations. The *Manual* itself will be kept up-to-date on a biennial publication schedule, and is available to outside parties at $100 per copy. Tape and punched card versions are also available at cost.

Chairmen of the Computer Group during the three-year preparation, in addition to Mr. McGuire, have been L. H. Bateman of *British Overseas Airways Corporation* and C. Hunderup of *Scandinavian Airlines System.*

ALGOL 60 Programming School

An intensive course of twelve lectures on Algol 60, organised by the Automatic Programming Information Centre at Brighton College of Technology on April 5, 6 and 7, was attended by 82 people. The course was concerned both with the nature of the language and the problems of implementing a suitable compiler.

In the first three sessions M. Woodger explained the basic structure of the language and also the notation used in the Algol 60 report. He went to some length to demonstrate the completeness of this report. In a further three sessions P. Naur explained the facilities included in Algol 60 for programmer defined procedures and functions. Examples worked during this time served to clarify the nature of the language.

E. W. Dijkstra explained some of the techniques used in an implementation of Algol 60 in connection with the X-1 computer. The recursive properties of Algol 60 present certain difficulties to the implementor and Dijkstra concerned himself largely with methods of overcoming these. For one session F. Duncan described the KDF 9 computer and outlined some work that *English Electric* were to do in respect of Algol 60.

The remaining sessions were devoted to questions and answers and some comments by P. Landin on the errors made in the programming examples that he had marked.

The success of the school was due at least in part to the facilities provided by the APIC, particularly in respect of documentation, and to the enthusiasm of the tutors for Algol 60.

Computer Business

At a recent press conference, a professional journalist asked whether any electronic computers were being exported from the United Kingdom. There were affirmative nods all round, but none of the manufacturers' representatives wanted to indulge in private advertising and no one had any total figures to hand. For the information of members and subscribers we have therefore extracted the following figures from Table 84, "Deliveries of certain scientific and industrial instruments and apparatus" in *Monthly Digest of Statistics*, No. 183, March 1961, published for Central Statistical Office by Her Majesty's Stationery Office, London.

Electronic Computers
(United Kingdom)

Year	*Total Deliveries*	*For Export*	*Percentage Exported*
1957	£3,745,000	£ 850,000	22·7%
1958	£5,268,000	£1,023,000	19·4%
1959 1st quarter	£1,654,000	£ 245,000	
2nd quarter	2,174,000	539,000	
3rd quarter	1,333,000	392,000	
4th quarter	2,501,000	914,000	
	£7,662,000	£2,090,000	27·3%
1960 1st quarter	£2,036,000	£ 494,000	24·3%
2nd quarter	1,255,000	541,000	43·1%
3rd quarter	2,094,000	726,000	34·7%

The figures relate to goods made in establishments classified to subdivisions 2 and 5 of the scientific, surgical and photographic instruments, etc., industry (minimum list heading 351 of the Standard Industrial Classification, 1958), and they also include goods made in establishments classified to the radio and other electronic apparatus and the office machinery industries. The heading "Electronic Computers" includes digital and analogue computers and machine-tool position controls for use with computers. These definitions are taken from *Supplement to Monthly Digest of Statistics: Definitions and Explanatory Notes:* Revised January 1961.

The percentages were calculated on an imported desk

calculator! Those, who have been informed that their electronic computers will be several months late in delivery, may find some solace in the thought that computer exports are helping to pay for imports.

Oxford University Computing Laboratory, Summer School 1961

In September 1960 the Computing Laboratory, in association with the Delegacy for Extra Mural Studies, organised a two-week "summer school" on numerical analysis associated with linear algebra and differential equations. About 80 representatives of universities, government laboratories and industrial concerns attended the course.

This year the material will be restricted, but with treatment at a more advanced level, to ordinary and partial differential equations and integral equations. The early lectures, provided by the members of the computing laboratory, will include basic theory, with emphasis on stability of numerical techniques, use of Chebshev polynomials, non-linear problems and so on, and will be followed by lectures on practical problems, given by representatives of AWRE (Aldermaston), UKAEA (Harwell), War Office (Fort Halstead), Meteorological Office (Dunstable), CEGB (London), and London University. These lectures, in addition to discussing programming techniques involved in large problems, include further applications of the theory, for example to the calculation of atomic structures, the solution of the Hartree-Fock equation, integro-differential equations, elliptic equations in nuclear reactor problems, characteristics and other methods for one-dimensional unsteady hydrodynamics, characteristics in more than one dimension, quasi-linear parabolic equations in more than one space dimension, the linear transport equation in one and two dimensions, Monte Carlo methods for neutronic problems, some problems in plasma physics, and the differential equations of numerical weather prediction.

The course will start on Monday, 28 August, and end on Friday, 8 September. Applications for places should be made on a form obtained from the Secretary of the Delegacy for Extra-Mural Studies, Rewley House, Wellington Square, Oxford, and will be accepted mainly from those with some present knowledge of the solution of differential equations. The standard fee for the course, exclusive of board and lodging, is £30, but it is probable that this will be reduced for academic representatives lacking financial support.

UNESCO Fellowship

Dr. John P. Cleave, Lecturer in Mathematics at the University of Southampton, has been awarded a Unesco Fellowship in Switching Theory.

Dr. Cleave, London born (1930), began research work in 1954 in the Department of Numerical Automation, Birbeck College, London, after obtaining an Honours degree in Mathematics and a Diploma in Electronics at the University of Southampton.

UNESCO Fellowships in Information Processing and Automatic Computation

The six fellowships which have been authorised under this scheme are planned to enable highly qualified specialists to undertake research study abroad for a period of six months in one of the following fields:

1. Mechanical translation.
2. Reduction of geophysical data.

Candidates applying for these awards should have the following qualifications:

1. *Mechanical Translation*

A. Candidates should be research workers who have already conducted or are in the process of conducting an experiment in mechanical translation and who wish to compare their methods with those of specialists engaged in the same work in other countries;

or

B. Candidates should be research workers who have planned an experiment in mechanical translation and who need, in order to initiate the experiment advice and mechanical facilities that can be found only in other countries;

or

C. Candidates should be research workers who wish to specialise in mechanical translation and who, in order to do so, need substantial training that cannot be provided in their home country in one of the disciplines relevant to mechanical translation.

2. *Reduction of Geophysical Data*

Candidates must have a doctorate in physics, geophysics or astrophysics, with a good mathematical background.

There exists a vast mass of observational data and records relating to geophysical phenomena, which await reduction and analysis. The successful candidates will be expected to study the possible application of modern automatic computing methods to this problem. The study programme may include:

(*a*) a period of study and selection of a problem in a World Data Centre or an Astronomical and Geophysical Permanent Service;

(*b*) a period of study of automatic computing machines in an appropriate laboratory or computing centre;

(*c*) the preparation and execution of a computing program for the analysis of the selected problem.

Interested readers should write to the Ministry of Education (Reference ER6/2/5) requesting that full information should be supplied when it becomes available.

Computer Analysis of Census Schedules

During the week-end 22–24 April, throughout England, Wales and Scotland, some eighty thousand Census enumerators delivered to every householder a schedule of questions to form the basis of the 1961 Census of Population. Twenty-four hours later, collection of the schedules began and the work of preparing population statistics is again under way, as it has been every ten years since 1801, with the single exception of the war year 1941.

The task of analysing the answers to questions put to upwards of fifty million people has this time been handed over to an electronic computer, for the first time in the history of the United Kingdom Census.

The IBM 705 Computer recently installed by the Royal Army Pay Corps in a new building at Worthy Down, in Hampshire, for processing the whole of the Army payroll,

will be used to edit, analyse and arrange information from the Census schedules into statistical reports in little more than half the time which has been required in the past.

The value of using a computer in work of this kind is not only the speed at which it works, but also the detailed checks on compatibility and accuracy which the computer allows, ensuring a degree of control over error and inconsistency in the published reports never before attainable.

The first report based on manual tabulation of the district totals of population, was produced in May; the work will be completed within three years, instead of the six or seven years formerly needed for the complete processing of the National Census. Further details of the Census procedure and proposed computer editing operations were given in a paper by Mr. Benjamin in the *R.S.S. Journal*, Series A, 1960, No. IV.

IFIP CONGRESS 62

Call for Papers

The International Federation of Information Processing Societies (IFIPS) will hold a Congress in Munich, Germany, from 27 *August to* 1 *September* 1962.

The Congress will cover all aspects of Information Processing and Digital Computers including the following:

(1) *Business Information Processing*
e.g. data processing in commerce, industry, and administration.

(2) *Scientific Information Processing*
e.g. numerical analysis; calculations in applied mathematics, statistics, and engineering; data reduction; problems in operations research.

(3) *Real Time Information Processing*
e.g. reservation systems; computer control; traffic control; analog-digital conversion.

(4) *Storage and Retrieval of Information*
e.g. memory devices; library catalogues.

(5) *Language Translation and Linguistic Analysis*

(6) *Digital Communication*
e.g. encoding; decoding; error detecting and error correcting codes for digital data transmission.

(7) *Artificial Perception and Intelligence*
e.g. pattern recognition; biological models; machine learning; automata theory.

(8) *Advanced Computer Techniques*
e.g. logical design; logical elements; storage devices; ultra high-speed computers; program techniques; ALGOL.

(9) *Education*
e.g. selection and training of computer specialists; training of non-specialists in the use of computers; information processing as a University subject.

(10) *Miscellaneous Subjects*
e.g. growth of the information processing field.

In each category it is planned to cover, where appropriate, the applications of digital computers, programming, systems design, logical design, equipment, and components.

Those wishing to offer papers are invited to send abstracts of 500–1,000 words to:

M. V. Wilkes,
The British Computer Society,
c/o University Mathematical Laboratory,
Corn Exchange Street,
Cambridge,

by 15 *September* 1961. These abstracts will be considered by the international program committee of IFIPS, and authors of selected abstracts will be invited to submit their complete papers (in French or English) for consideration by the program committee in March 1962.

In addition to accepted papers, there will be invited papers, symposia, and panel discussions.

CORRESPONDENCE (*continued from p.* 46)

which follows the normal mathematical presentation more closely.

Since it appears that ALGOL 60 translators are now being written for some of the bigger machines coming on the market and that some computer manufacturers apparently have already decided on proposals for including matrix facilities in their translators, it would seem that a time for deciding on a recommended method for including them is NOW, and not in a year's time when the compilers will have been written and people will be unwilling to change.

Atomic Power Constructions Ltd.,
28 Theobalds Road,
*London, W.C.*1.

Yours, etc.,
J. B. POLLARD

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THE BRISTOL CONFERENCE – "THE COMPUTER CO-OPERATIVE"

A very successful Conference was held by the Bristol Branch at Queen's Building, University of Bristol, on 28 March. The subject under investigation was the possible establishment of computing installations owned by groups of smaller firms in this country.

The principal speaker was Mr. J. P. Loorij, who spoke about such an establishment which had been created in the Netherlands at Amsterdam. The Society for Central Electronic Administration, where Mr. Loorij is head of IDP and ADP Research, installed a UNIVAC Computer in January of this year, primarily for the purpose of calculating payrolls for its member firms. Mr. Loorij, whose paper is reproduced in this Bulletin, described the events leading up to the decision to install a computer, and the subsequent preparations for the installation.

Mr. Loorij was supported by Mr. A. R. P. Fairlie of *Remington Rand Ltd.*, who described the equipment which had been installed at the Dutch Centre.

Mr. T. A. Robinson of *Job White and Sons*, Leek, showed how his firm had used a computer service bureau to solve their production problems, and the degree of control which had been achieved, illustrating some of the benefits available to the smaller organisation.

The last speaker, Mr. H. W. Matthews, of *Urwick Diebold Ltd.*, drew the attention of those present to the magnitude of the problems which any proposed co-operative must solve, and warned against the danger of underestimating them.

A period of general discussion at the end saw many questions posed, many of them directly to Mr. Loorij, who gave many facts and figures in illustration of his answers.

The Conference was attended by some 115 people, and the Chairman was Mr. G. P. Wade, Director of Work Study and Staff Training, Engineering & Allied Employers' West of England Association.

In summing up, Mr. Wade emphasised that the initiative for such a computer co-operative in this country should come from the potential small users, rather than being fostered by larger bodies. He also praised Mr. Loorij's part in the Conference, particularly in respect of his readiness to supply details, and not least in his fine command of English. The Chairman also congratulated the Bristol Branch on its enterprise in holding a Conference on this topic.

Iron and Steel Institute

The Annual General Meeting 1961 of the Iron and Steel Institute was held on 3–4 May 1961 and included three Technical Sessions on Computers in the Iron and Steel Industry.

COMPUTERS IN RESEARCH AND DESIGN

CARTWRIGHT, W. F., THOMAS, G. W. (*Steel Company of Wales Ltd.*): The Integration of Process Control, Production Control and Data Processing.

OWEN, D. G. (*United Steel Companies Ltd.*), TAYLOR, R. J. (*BISRA*): A Survey of the Technical and Scientific Uses of Computers in the Iron and Steel Industry.

HODGE, A. L. (*Linde Company*): Some Aspects on Predicting Blast-Furnace Behaviour.

RHODES, M. S. (*United Steel Companies Ltd.*): Use of a Computer in Heat-Transfer Studies.

MORGAN, L., HUTSON, W. M. P. (*United Steel Structural Co. Ltd.*): Structural Design by Computer.

COMPUTERS FOR PROCESS CONTROL (In-Line)

Discussion on the Use of Computers in cutting up Steel Product, introduced by R. H. BAULK (*Samuel Fox and Co. Ltd.*) and W. E. SCOTT (*English Electric Co. Ltd.*).

Discussion on the Use of Computers in Mill and Furnace Control, introduced by W. E. SCOTT (*English Electric Co. Ltd.*), G. W. VAN STEIN CALLENFELS (*KNHS, Ijmuiden*), W. J. SLATOSKY (*Jones and Laughlin Steel Corporation*), H. S. MAXWELL (*General Electric Company, Schenectady*).

COMPUTERS IN PRODUCTION CONTROL AND INFORMATION

HOPKINS, C. LL., COURT, M. E. (*Steel Company of Wales Ltd.*): A Feasibility Study in the Mechanisation of Clerical Procedures in a large Steel Company using a Computer.

BOUCHAUD, P., FEROLDI, J. (*SOLLAC, France*): Application of a Computer at a Works making Flat Products.

ARCHIBALD, H. I. A. (*Stewarts and Lloyds Ltd.*): The Application of a Digital Computer to the Operation Problems of the Extraction and Supply of Iron Ore. (Already published in the *Journal of the Iron and Steel Institute* for April 1961.)

BEYNON, P. (*Steel, Peech and Tozer*): Weekly Casting Bay Programs.

Copies of most of these papers are available and both they and the discussions at each Session will eventually be reported in full in the *Journal of the Iron and Steel Institute*.

THE ORGANISATION OF AN ADP CENTRE

*by J. P. Loorij**

Introduction

On 6 July 1960 the *Vereniging voor Centrale Elektronische Administratie*, abb. CEA, was founded on behalf of the Centraal Sociaal Werkgevers Verbond, the Verbond van Nederlandse Werkgevers, the Katholiek Verbond van Werkgeversvakverenigingen and the Verbond van Protestant-Christelijke Werkgevers in Nederland.

The CEA aims at giving the advantages of the use of electronic data processing machines to small and large companies and through this to relieve the participating companies of a great quantity of administrative detail without affecting anything that is special to these companies, or taking any management responsibility in the field of administration. For the time being the CEA will mainly confine itself to the field of payroll administration. However, due to certain inquiries, the CEA will pay attention also to the possibility of taking over other activities of the administration. Those possibilities will be considered for each individual case.

Preparation and Lay-out

Technical and Practical Possibility

What are the possibilities of a centralised electronic equipment for the payroll administration?

1. *Nature and extent of existing payroll administrations*

Sixteen companies from many different business sectors and of different sizes were visited by a working committee to get an impression of the nature of the existing payroll administrations. It appeared that in addition to the way in which the payroll administration is done, the factors playing a part in the computation of the wages differ very much. Even in employment under the same labour agreement the differences in administrations, due to existing special rules in many companies, are still very large.

Our guiding consideration during the application study was always that *which was special to any administration, had to be left unchanged as far as possible.*

With this starting point in view, one looked for an answer to the question as to how this diversity of administrations could be catered for with central processing of payroll information.

In the first place a machine is needed which can be switched from one program to another in a fast and safe way. Only then each company can have its own program with its specific requirements.

Furthermore, the machine should have a "memory" big enough to process the entire program of a company in one run. Such a program covers at least several thousands of instructions.

Is it possible to make one program which could be used for all the participating companies? For a limited number of components of the wage computation, such as the computation of the premium of the state pension, the programs will be the same for all the companies. It is also possible to put all the deviating parts of a payroll computation together in one comprehensive program. Such a program has been designed to demonstrate clearly the unity in the diversity which can be reached by the central processing of information with an electronic machine.

However, for several practical reasons the use of such a "universal" program has to be discouraged at least in the starting period. It is true, there will be a number of mostly small companies which for the sake of efficiency will standardise their payroll administration in such a way that they can act for the centre as one participant, so that only one program has to be made. The same will be valid in cases in which these administrations deviate only in details, at least if those deviations can be put into one program.

2. *The advantages of the processing of administrative data by means of an electronic machine*

In view of the satisfying results everywhere obtained with conventional punched-card machines, one asks why an electronic machine has to be used for the co-operative processing of payroll administrations. The use of a fairly large electronic machine specially for payroll gives the idea of shooting a sparrow with an anti-aircraft gun, at least when it concerns a payroll for one single company.

For a centre, however, the matter is much different. Investigation has shown this quite clearly. The very divergent demands, which the different companies will make on the centre as regards the work to be done for their payroll administration, make the *sparrow* of the single company into a dreadful monster.

In other words, in central processing the diversity of the work forces the centre to use equipment which can handle this variation of procedure with great *security*, *speed* and *flexibility*.

The electronic machine offers these possibilities to a greater extent than the conventional machines.

Security

Due to the many check possibilities the electronic equipment can take better care of the strict time-table of the activities. Some checks are built into the electronic machine, others have to be programmed.

When using conventional punched-card systems the timetable can be severely disturbed by the fact that (machine) errors can only be discovered and corrected afterwards by a special test. Owing to the much bigger memory-capacity and the selection-possibilities of an electronic machine it is possible to unify the different actions in one run in one machine which otherwise have to be executed with several conventional machines. This integration greatly improves the reliability of the system.

* Society for Central Electronic Administration.

Speed

The high speed which can be obtained with an electronic machine, also advances the integration, which is here synonymous with reliability. It is true that the same speed can be obtained with conventional machines, but only if more of these machines are put into operation. This, however, further disturbs the integration and the reliability becomes smaller.

Flexibility

The setting of an electronic machine by means of program-cards or tapes is simpler than, for instance, the setting of a tabulator in the conventional punched-card system. Simpler because it is possible to have the different kinds of instructions done by the machine in sequence.

The program-cards of the next work can be put into the machine immediately after the last punched cards of the previous work. This can be done without stopping the machine. In case of conventional tabulators on the other hand we have to exchange and alter patchpanels and we have to set the machine again, which always will give an interruption. Because of the fact that the program is self-checking, it is also easier, as compared with punched-card machines, to determine if the right program is going to work on the right working cards. The most important aspect of the flexibility is perhaps the ease of changing and extending the program.

In some cases the only work to be done is punching a new program or a new program card, whereas in using conventional machines a patchpanel has to be altered.

3. *The confidentiality of the data*

The confidentiality of the data in central processing of the payroll-records has to be fully guaranteed. Therefore the centre is never allowed to hand the data or information about the data, which it has available, to unauthorised persons unless the company concerned gives the explicit order to do so.

The organisation which is in charge of the processing of the work, must keep this aspect firmly in mind.

4. *Communication between the companies and the centre*

In central processing of payroll-records, fast and safe communication between the companies and the centre is necessary, for the data have always and under all circumstances to be at the disposal of the companies in time before pay-day. It is also self-evident that the basic items of the companies have to reach the centre always in time. When giving an order for processing payroll-records, the company and the centre have to draw up a fixed time-table for sending data to and from the centre.

In order to judge if such fast communication was possible, it was presumed that the co-operating companies would be spread over the whole country.

The confirmation of this supposition was found in the results of a survey, which was held in November 1959 by the CSWV among their members, some three thousand in all.

With these data as a basis the transport possibilities were discussed in detail with the Netherland Postal Department (PTT) and the Netherlands Railways Company (NS).

One of the conclusions was:

In whatever form the data is supplied and wherever the company may be situated, the forwarding of the data to and from the centre, inclusive of the processing time needed by the centre, can be completed within 36 hours.

As an illustration we give the following examples:

(*a*) The transport of punch-operator forms by mail:

Location of company	Last time of delivery to the local post office	Arrival of the train in Amsterdam	Last time of delivery for the nightmail-train from Amsterdam (Central Station)	Arrival of the mail at the company's locality
Veelerveen	15.50	23.13 or 2.04 next day	22.30	8.00
Koog a/d Zaan	20.45	23.22	22.30	4.55
Rotterdam	23.00	3.11 next day	22.30	4.00
Heerlen	21.00	2.21 next day	22.30	5.35
Maartensdijk	18.55	0.12 next day	22.30	6.30
Hallum	17.35	23.13 or 2.04 next day	22.30	6.30
Hoogeveen	20.45	23.13 or 2.04 next day	22.30	3.53
Delden	19.00	23.13 or 2.04 next day	22.30	6.15
Culemborg	19.50	0.12 next day	22.30	5.10
Tilburg	21.00	23.58	22.30	2.42
Kruiningen	19.20	23.34	22.30	6.45

(*b*) The forwarding of punched cards by train:

When forwarding goods by passenger trains of the Dutch Railways the delivery at the station can take place up to 6 p.m., the time for picking up the goods at the station being about 36 hours later, viz. 8 a.m.

From the investigation it appeared that the safety and regularity was best when sending the data by nightmail-train. Where needed the daytime-traffic can also be used, but in the opinion of the investigators this must be restricted for special cases. For a fast transport of data it is advisable to deliver and pick up the mail as far as possible at the station or post office. Special local arrangements will be made for this purpose in due course.

It is in general not advisable to have the transport in the charge of employees of the centre—neither by train nor by car—apart perhaps from cases in which a great number of co-operating companies are concentrated in a small area. The vulnerability of one's own transport is greater due to the possibility of accidents and of bad weather conditions, whilst the costs are also considerably higher. The advantages of a little more flexibility in the organisation of the transport is counterbalanced in our opinion by these difficulties.

5. *The staggering of the activities over the days of the week*

When the payroll-records are processed by a centre it will of course not be possible to do all activities in one or two days of the week. First of all this would not be efficient, for the electronic machine in that case will only be in use for a fraction of the time available, which would increase the costs per job. Moreover, it would not be practically possible to process the data of so many companies within one or two days.

Therefore it is important if it is at all possible to spread the activities, taking into account the time needed for transport and processing of the payroll-records, over the period between the end of the payroll-period and the pay-day.

Experience teaches that most companies already pay their wages a few days after the end of the payroll-period.

So in most cases there is sufficient margin to spread the activities over the days of the week. In these cases the

co-operating companies need alter neither the payroll-period nor the pay-day. The concentration of the work within certain days of the week, however, has to be avoided. If this occurs, the centre and the companies concerned have to look for a solution which will usually not produce great difficulties.

6. *The possibility of preventing and dealing with interruptions*
When payroll-records are processed by a centre interruptions will probably occur. These can be caused by:

(*a*) a breakdown of the electronic machine;
(*b*) the data being damaged or destroyed.

Apart from calamities, one must always be sure that these interruptions can be dealt with and that they will never lead to a delay in the paying of the wages by the companies.

As regards the breakdown of the electronic machine practice has shown that a machine, which has a regular preventive maintenance period and good repair facilities, seldom or never stops in case of a mechanical trouble. Nevertheless, this possibility has to be taken into account. Furthermore, it is possible that the machine stops due to power failure. The following provisions will be needed to deal with these interruptions:

(i) an emergency set to generate electric current;
(ii) the guarantee to have reserve equipment available elsewhere, which can take over the job in case of trouble.

The possibility mentioned under (*b*) must be taken into account. This is taken care of by making a second file of all the data processed by a centre.

Technical Set-Up of the Association for Central Electronic Administration (CEA)

The guiding consideration is that it is only possible to process the data efficiently when this processing is *data integrated*. The meaning of this is that the processing of the data must form from start to finish an unbreakable chain of events, which are executed by the electronic machine, without any human intervention.

With this aim in mind the following points have to be considered:

A. Relations between the participating companies and the CEA;
B. The procedure;
C. The way of storing the elementary or masterfile data;
D. The security of the masterfile;
E. The processing of the data by the electronic machine;
F. The moment and the conditions under which the CEA can start its activities;
G. The preparation of programming data by the payroll-clerks.

These subjects will be discussed in sequence.

A. The relation between the participating companies and the CEA
This subject can be divided into two main points:

1. What restrictions have to be made on the basic input data, collected by the companies, to enable the CEA to translate these data for the electronic machine?
2. What restrictions have to be made by the CEA with regard to the output payslips?

Concerning these two points we notice:

In principle the participant is allowed to deliver the data to the CEA in any form whatever. However, variations in the presentation of the data will result in a higher cost, due to the translation of the data into the electronic machine language.

CEA provides each customer with a certain amount of flexibility in the final printed payroll-form. In other words adjustment can be done in order to meet special requirements. For example, the pre-designed payroll-form contains one or two lines of masterheading information. The other lines are reserved for changes in heading dictated by specific customer. The result will be a combination of fixed and variable headings. It would be too expensive to handle for every single firm special pre-printed pay-slips, because in that case the printer would have to be reprogrammed for each individual company.

B. The procedure
A short enumeration of the successive actions of the basic procedure follows. The numbers before the successive steps refer to the diagram on page 15.

INDICATIVE DATA:

1. The masterfile data per employee is made available to the CEA at the moment on which the company wishes the CEA to process the payroll-administration. The company provides at the same time a check total of the data.
2. Having received the masterfile data, certain data are coded. For instance, every employee obtains an employee number.
3. The punching and the verifying-punching of the masterfile data.
4. For every employee one mastercard is made in which appears, next to the masterfile data, a company-registration number given by the CEA. This number shows in what undertaking the employee works.
5. The punched masterfile-cards are interpreted, which means that the punched holes are made readable on the upper part of the card with the aid of a machine.
6. The masterfile-cards are sorted per company in sequence of the registration number.
7. The punched masterfile-cards are duplicated with the aid of a reproducer which is automatically controlled.
8. The duplicated punched cards are printed, after having been interpreted. In this way the so-called masterfile-list is produced in duplicate. The totals of this masterfile-list are verified with the check total (see section 1).
9. When the duplicate masterfile-cards and masterfile-list are found correct they are sent to the company. A copy of this list will be kept by the CEA. The masterfile data, furnished by the company (see section 1), are also returned.
10. The company verifies the masterfile-list and the duplicated masterfile-cards, to be sure that the CEA has interpreted the data in the right way.
11. The CEA stores the original masterfile-cards. The cards are now available for use.
12. When changes take place, the following rules must be considered:

    (i) changes of data for an employee. The duplicated mastercard is sent by the company to the CEA. On

this card the changes are *written* down. (In order to leave the duplicate masterfile intact, a card of dissimilar colour is placed in the file instead of the card which is taken away.)

(ii) The masterfile-card of a retiring employee will be returned by the company to the CEA with a note.

(iii) For a new employee the company fills up a form supplied by the CEA and sends it to the centre.

13. If necessary the CEA codes the changes received from the companies. For the rest the changes are processed in the same way as described in sections 3 to 11. Thus the company receives a duplicate masterfile-card and a supplementary masterfile-list. An up-to-date masterfile list can be made, if necessary, from time to time.
14. If necessary the CEA can make for every payroll-period a punch-operator instruction form with all the constant data, which the company only has to complete with the variable payroll-data.

THE PAYROLL DATA

15. The supply of the payroll-data can take place as follows:
    (*a*) The company supplies the punch-operator instruction form per payroll-period. These forms either are furnished by the CEA or designed by the company in agreement with the CEA. The company can also deliver the payroll-data on their own forms.
    (*b*) The company supplies per payroll-period one or more punched cards per employee, furnished by the CEA, on which the company has marked certain variable payroll-data ("mark sensing"-system).
    (*c*) The company supplies per payroll-period its own punched cards.
16. The payroll-data of the punch-concepts are punched. The CEA does not make a second file of these cards, because the original payroll-data can act for this purpose.
17. The mark sensing cards from the companies are punched with a mark sensing reproducer.
18. For purpose of replacing cards which might be lost in the case of a card-jam or any other accident the marked cards are punched in duplicate.
19. The punched cards supplied are also duplicated for the same reason.
20. The CEA keeps the duplicated punched cards, as mentioned in sections 18 and 19, as reserve cards.
21. For every employee a wage card is created with all the payment components and a deduction card with all the deduction components.
22. All the payment- and deduction-cards are printed with the aid of a tabulator; a total is made of the data.
23. Together with the other documents prepared by the CEA, this list is sent to the company. This company is now in a position to check whether the CEA has interpreted the data in the right way.
24. The payment- and deduction-cards are interpreted.
25. The cards are sorted per company in sequence of the employee-numbers.
26. The masterfile-cards are collated per company with the payment- and deduction-cards. This processing is done by selection, which means that the machine automatically sorts:
    (*a*) Masterfile-cards of which no payment and deduction cards are present;
    (*b*) Payment and deduction cards of which no masterfile-cards are present.
27. The program is stored into the memory of the machine by means of program cards. Hereafter the masterfile, payment and deduction cards are read in.

The electronic machine produces:

28. A pay-slip per employee per payroll period on which are mentioned the payroll components.
29. A payroll-list, if needed with several copies, and summarised in a general total.
30. A punched card with certain data or totals for other summaries, reviews and statistical items which the company wishes to receive.
31. Periodically a total payroll-list.
32. Periodically statistical reviews.
33. The masterfile-cards which are refiled.
34. The payment and deduction cards which are put away in a waiting file.
35. The cards which will not be used for the next payroll-period. These go to the so-called dead-file.

The receiving of the basic-data by the CEA as well as the despatching of the pay-slips and other documents to the companies take place according to a contract, drawn up by the company and the CEA.

C. The way of recording the basic-data

The companies which agree with the CEA upon the processing of their payroll can be divided into four categories, according to the form in which they furnish the data:

(i) Companies which prefer to maintain their usual way of recording, though this recording, as regards sequence and contents, does not correspond to the requirements of electronic processing. This need not to be a difficulty, but it takes more time to change these data into machine language.

(ii) Companies which (by consultation with the CEA) are willing to use a form which can be filled up in the right sequence with all the data which the CEA needs to make the punched cards.

(iii) Companies which have punched-card machinery at their disposal, so that they can give the CEA the data needed for electronic processing in the form of punched cards.

(iv) Companies which give the data needed for electronic processing to the CEA in the form of mark sensing cards.

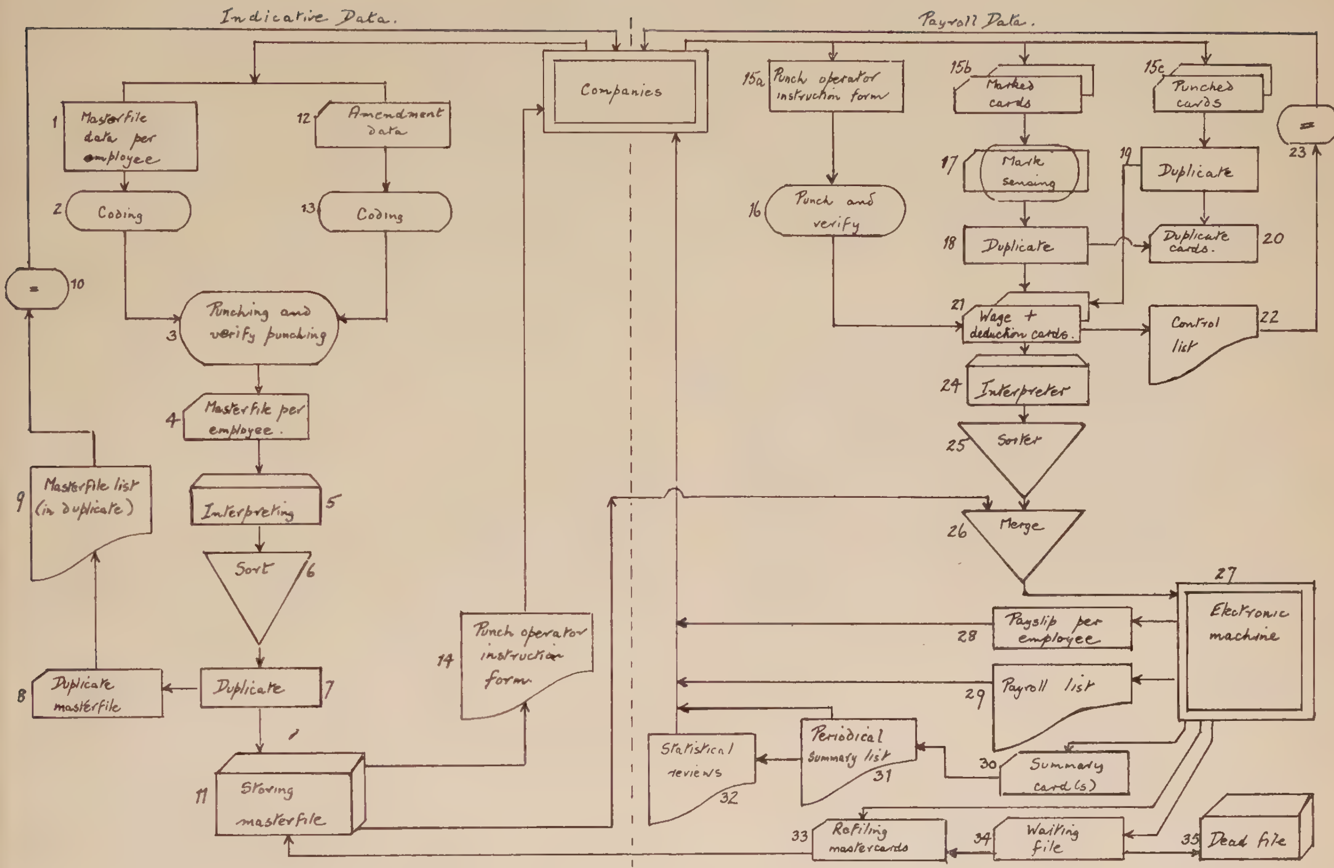
D. The securing of the basic material

The chance of delay due to data being damaged or getting lost is very small. Nevertheless it must be possible, certainly in the starting period, to fall back on the basic data in case of unexpected trouble in the transport from one point to another, or when the basic material (punched cards) is damaged.

Thus it is advisable to make reserve-files. These reserve-files may be composed as follows:

(*a*) The payroll-data recorded on punched cards from companies of categories (i) and (ii) will be kept as a reserve-file until the work is done. In case of difficulties the data as far as needed can be again recorded on punched cards.

(*b*) The data of the companies of the categories (iii) and (iv) recorded on punched cards, will be duplicated by the CEA with a reproducer; this duplicated file has only to be kept for a short time.



Indicative Data.
Payroll Data.
Companies
1 Masterfile data per employee
2 Coding
12 Amendment data
13 Coding
3 Punching and verify punching
4 Masterfile per employee.
5 Interpreting
6 Sort
7 Duplicate
8 Duplicate masterfile
9 Masterfile list (in duplicate)
10
11 Storing masterfile
14 Punch operator instruction form
15a Punch operator instruction form
15b Marked cards
15c Punched cards
16 Punch and verify
17 Mark sensing
18 Duplicate
19 Duplicate
20 Duplicate cards.
21 Wage + deduction cards.
22 Control list
23
24 Interpreter
25 Sorter
26 Merge
27 Electronic machine
28 Payslip per employee
29 Payroll list
30 Summary card(s)
31 Periodical summary list
32 Statistical reviews
33 Refiling mastercards
34 Waiting file
35 Dead file

E. The data processing by the electronic machine

The activities of the electronic machine for the payroll-administration can be summarised as follows:

(*a*) Computation of the gross pay;
Computation of the other pay-components;
Computation of the deductions;
Specified recording from gross to net pay on wage slips, payroll list, etc.

(*b*) Production of additional information which is necessary for the book-keeping, balancing of accounts with other companies or governmental requirements (inc. taxes, etc.).

(*c*) Special cards are produced for updating certain information during the next run of the computer.

Not all the requirements of all companies are mentioned in the above description. This description has only the character of giving the general lines of the CEA policy.

The requirements which the CEA makes on an electronic machine can be summarised as follows:

IN- AND OUTPUT OF THE DATA

In order to be able to guarantee a safe and on time processing of the data, the input of the data will be done with the aid of *punched cards*, in any case during the first years:

(*a*) much experience has already been obtained with the punched card in the so-called (conventional) punched-card system. This experience will surely stimulate a fast start;
(*b*) the participating companies which already have punched-card systems at their disposal, can deliver their data in punched cards. This saves time and money;
(*c*) the data recorded on punched cards are easily adapted.

The magnetic tape lacks these advantages. But other benefits can be noticed:

(*a*) the speed of in- and output is much higher than when using punched cards;
(*b*) items of dissimilar length are easier to process;
(*c*) the magnetic tape stimulates DP integration;
(*d*) the tape forms an unbreakable file of about 15,000 up to 66,000 punched cards;
(*e*) the tape needs less storage room;
(*f*) the same tape can be used several times.

Other advantages and disadvantages of cards, tape and other input media can be left out of consideration here.

Because of the fact that we have got hardly any experience in our country with magnetic tapes, the CEA has chosen an electronic ADP system with a fast card-reader, with a read-validity-check built in, by means of a second reading station and with the possibility of extension of the in- and output by means of magnetic tapes.

N.B. Two punched-card input units are preferable to one, because in such a case masterfile-cards and amendment cards have not previously to be collated. However, the fact that the card-file of a payroll-administration has many amendments, means that pre-sorting with a sorter of a collator can speed up the process of the electronic ADP machine.

Thus the double punched-card input improvement of the integration is not such a striking advantage. It is true that the extra run through a sorter, which is needed for an electronic ADP machine with only one input, disturbs the integration, but on the other hand there is the advantage that the input will be much "cleaner."

The facility in having more than one output stacker in the reader, is a great advantage. It allows the programmed selection of cards after they have been read and processed by the machine. The sorting of the cards with the aid of a sorter after the processing by the electronic machine means a greater disturbance of the integration than the merging before.

PROCESSING CAPACITY: CHARACTER, SPEED AND CAPACITY OF THE MEMORIES

Character and speed

In administrative problems the in- and output speed is more important than transferring and computation speed inside the machine. In this case we do not demand that the data in the memory of the machine being randomly accessable, although this would mean an advantage for most efficient program. In view of the relative slow in- and output—it is a fact that the payroll-administration works with a rather large number of data and results—such perfect programming is not always needed.

As a matter of fact the more the in- and output is speeded up the greater is the need for higher transfer speed and computation speed. All these facts have to be considered when choosing an electronic machine.

THE CAPACITY OF THE MEMORY

A provisional program investigation has shown that the memory must have at least 40,000 to 50,000 locations. A machine with a smaller memory capacity will in most cases not be able to process the work in one machine run. This is undesirable when a great number of different jobs are centrally processed.

In view of diversity of the jobs to be done the processing by the electronic machine has to be integrated as much as possible. A second run by the machine disturbs the integration to some extent. Even when in the programming of the second run checkpoints could be inserted through which the machine could signal possible mistakes which happened between the two runs, delays would be the result. The fact that the processing time in case of a second run would double need not to be a difficulty, because in that case two machines each with 20,000 to 25,000 memory locations could be used. Two machines instead of one might even be advantageous because the risk of a hold-up would be cut in half.

However, in view of the higher costs, and apart from this in view of the desirability of as great an integration as possible, one machine with 40,000 to 50,000 memory-locations was preferred to two machines with smaller memory capacities, though the vulnerability somewhat increased.

PROGRAMMING

The way in which the machine has to be programmed is important because of the great quantity and differences of the programs. Automatic programming gives an advantage in time of about 50% for the coding and certainly deserves recommendation. It is to be expected that for the payroll-administration the effort of programming (up to and including the flowchart) and the coding have a one to one relation. If it is possible for certain parts of the payroll computations, which have a more or less uniform character, to use the same

flowchart, this relation would become more favourable. A so-called dead-memory is in general valuable in cases of tables which are not subject to many changes. For payroll-administrations it is not so useful, because of the many changes and adaptations in the program. The loading and changing of dead-memory, such as a tax-table, costs time.

The program must be stored in the memory with the aid of punched cards; binary loading is preferable to decimal loading. Binary punched cards can contain three times as many instructions as decimal punched cards. This means that the machine reads its program in and out three times faster. This is not only important for storing the program but also when the machine creates, by punching, new program cards (e.g. changed tables). Memory dump on punched cards for checking or other reasons, as well as reloading, goes three times faster when it is done in the binary form instead of in decimal. It also gives the great advantage of a three times smaller file of program cards, table cards, checkcards, etc.

The storing of the program with the aid of punched paper tape can offer advantages above punched cards; paper tape leads to greater integration and takes less room. But for making changes the paper tape, just as the magnetic tape, is again less flexible than the punched card.

THE OUTPUT OF THE RESULTS

For the time being the electronic ADP machine must have a punched-card output, later magnetic tape units can be added. A validity check for punching has to be built in, for instance in the form of a check read station behind the punching station.

In regard to the printing of the data, especially with respect to the payroll and payslip the one-line principle was followed. The realisation of this with the aid of a high-speed printer is preferable because in this way the normally very fast processing time of the machine is hardly hampered and possible errors of the printed data are automatically signalled. The speed of punching and printing of the output is of the highest importance, because it sets the pace of the whole installation.

The printer equipped with a so-called split carriage or two independently moving paperfeeds means a great advantage, because of the possibility to process at the same time payslips and payrolls, which are different in form and contents.

A disadvantage of the one-line principle is the risk of slowing down the entire job, for instance by failure of the printer. So when choosing a machine high demands were made on the working reliability of the high-speed printer as on the other parts of the equipment.

THE PRICE OF AN ELECTRONIC ADP MACHINE

The rent and purchasing price of different electronic ADP machines show considerable divergences.

The information from companies, which, in reply to a survey, agreed that they intended to give the centre their payroll administration, acted as a starting point for the expected extent of the work to be done. Out of the presumed extent it is possible to fix almost exactly the staff and equipment suitable for the purpose and the yearly costs of the centre.

FREQUENCY AND QUANTITIES

The data so received are split up according to the actual payroll periods as follows:

***

Number of Companies	Number of employees			Total
	Weekly payroll	Monthly payroll	Other payroll periods	
235	61,892	20,847	—	82,739
28	13,900	—	—	13,900
13	—	2,760	—	2,760
12	5,390	2,085	8,584	16,059
10	1,298	—	394	1,692
10	—	933	2,474	3,407
308	82,480	26,625	11,452	120,557
Of these 36 have their own punched-card equipment:				
	14,951	7,570	3,870	26,391

As mentioned before, we have based our calculations upon 200 companies with 100,000 employees in all, split up as follows:

160 companies which have weekly as well as monthly payrolls;
20 companies with only weekly payrolls;
20 companies with only monthly payrolls;
75,000 employees who receive their pay weekly;
25,000 employees with monthly pay.

Furthermore, the number of companies which have a punched-card system of their own, is kept unchanged in the calculations with the number of their employees of 15,000 workers paid once a week and 7,500 workers paid per month.

In the estimate of costs the CEA has set aside an amount of fl. 300,000,– per year for an electronic equipment with which it is possible to compute and process the wages of 100,000 employees for about 200 companies. This amount of fl. 300,000,– includes a large sum as reserve.

In this calculation we have not considered whether the electronic machine will be rented or purchased.

The costs of the electronic machine for co-operative use are only a small proportion of the total costs. As appears from the above-mentioned figures, the costs of the electronic equipment amounts to fl. 3,– per employee per year, starting with a file of 100,000 employees.

F. The moment and the conditions on which the centre starts its activities

The CEA has to start with a rather small file. The enormous work of preparing the programs for different companies and the attempts to reach the best solution for the cost- and financing-problem, makes a gradual solution necessary.

To meet existing interests within a reasonable time, it was preferable for the CEA to start as soon as possible. In view of the fact that the preparations were nearly finished, this was possible. Because Centraal Beheer was in charge of the administration of CEA, and because they had already a group of programmers, working space, and last but not least the experience in programming of equivalent objects, the operation could be started without delay. One reservation had to be made: the necessary electronic equipment has to be set up at least two months before the start of the CEA operations. Therefore the machine with the shortest time of delivery had the preference.

It is true that with the necessity of a gradual start in mind it would be possible to use an equipment of another type as a temporary arrangement, if the concerned supplier could put

it at the disposal of the CEA. But this would involve also great difficulties, because in that case a system would have to be created, which could guarantee a gradual change from one system to another. Especially in programming and in designing the forms the difficulties would be great. Therefore a solution in this direction was not advisable.

G. The pre-programming by the payroll clerks

Detailed instructions for the machine (the program) would have to be prepared. In this program all the administrative actions are written down in diagramatic form (flow-chart). The next step is to translate all these actions into the machine language (coding). Finally they have to be stored in the input-medium (punched cards), paper punched tape, magnetic tape (or film). Up to and including the preparing of the input medium the programming of the machine can be divided into four stages:

1. A detailed description of the administrative activities, as they were done formerly (lay-out);
2. A diagram in a form suitable to the new methods, which will be followed when using an electronic machine (flow-chart);
3. Translation of the data from the flow-chart into the machine language (coding);
4. Transmission of this code in punched cards, tape or film (input-medium).

It will be clear that phase 1, the description of the actual method, has to be done by the payroll clerk, if it is not yet done. The CEA has carefully considered whether the payroll clerk could be useful for a lot of other work to be done.

Experience has shown, in this country as well as abroad, that the participation of suitable personnel from the administrative department of the company in the programming of the administrative processes gives better and faster results than when only outside people are used. In many cases it has appeared to be easier and more efficient to teach the "old dog" in the administration the general technical knowledge of the electronic machine—enough to enable him to make a flow-chart—than to teach the well-trained young technical programmer all the aspects of the administration of a strange company he does not know. This is chiefly valid for that part of the programming mentioned above under phase 2, the making of the flow-chart.

The more carefully phases 1 and 2 are done, the easier phases 3 and 4 can be dealt with by technical trained "outside" people. If the detailed description, the lay-out and flow-chart are really good, then as a matter of fact the transferring of the data of the flow-chart into the language of the machine, can very well be done by other people, unlike the first two phases.

Designing a flow-diagram is not an easy job. To analyse an administrative process is a difficult job, even for the experienced clerk. It is not easy to describe the administrative actions so that the stupid machine—for in fact the electronic machine is stupid—can understand and process them.

Apart from this difficulty, the reduction of all administrative actions into one "flow" is also not easy for it has to be done in such a way that as few as possible bends or obstacles remain.

It is exceedingly difficult for a system-analyst, who is not familiar with the technique of the electronic machine, to make a flow-chart of an easy administrative process.

So there will be the need for a special training for the payroll clerk, if he is to be able to take part in the programming with success. This training need not go so far that the payroll clerk can make independently a perfect flow-chart. Such a training, which even requires a certain talent, would last months. Neither time nor talent will always be available when trying to reach a solution for the programming problem in this way.

Therefore the perfect flow-chart will only be accomplished by or with the aid of the fully trained programmers of the CEA. These programmers, however, can get important help and they can reach their aim faster when at least the payroll-clerk is in a position to give them a rough diagram, in which already some fundamental requirements of the flow-chart have been taken into account.

This is what we call the "pre-programming." Much can be expected from this system by the ease and particularly by the speeding up it can produce as regards the extensive and time-consuming work of programming. It has proved to be possible in a training course of nine days, in which attention was paid only to the fundamental requirements, to teach enough of the material to the payroll clerks in order to enable them to do this pre-programming.

The CEA has organised this course as quickly as possible, and all over the country these courses take place, with the aim of employing the payroll clerks of the interested companies as soon as possible in the job of programming.

ICT and GEC

In 1956 *International Computers and Tabulators Ltd.* and *The General Electric Company Ltd.* agreed to associate and develop their specialist knowledge in their respective fields in regard to computers, through the medium of a jointly owned subsidiary entitled *Computer Developments Ltd.* (CDL).

In the light of experience, and in order to derive further mutual advantage from this association, ICT has formed a subsidiary to be known as *ICT (Engineering) Ltd.*, whose nominal capital will be held as to 90% by ICT and 10% by GEC. This Company will assume responsibilities now undertaken by ICT's Research and Design Division and by the GEC Computer Development Department at Coventry. GEC will continue to supply ICT with a substantial proportion of its steadily increasing requirements for electronic equipment.

ICT has, on the formation of the new Company, taken over the majority interest in *Computer Developments Ltd.*

Computer Abstracts

In our last issue we published a review of this periodical in which it was compared with *Computing Reviews*. We have been asked by the Editor to point out that *Computer Abstracts* has a different aim, namely to provide objective summaries of as many references as possible, and does not compete with *Computing Reviews* which aims to be critical.

THE PLACE OF CHARACTER RECOGNITION, DATA TRANSMISSION AND DOCUMENT HANDLING IN AN ADP SYSTEM

Reported by Daphne P. Kilner

A Report on a Conference held on Character Recognition, Data Transmission and Document Handling, 27–29 March 1961, by the Northampton College of Advanced Technology, London, in co-operation with the British Computer Society Ltd., which was attended by more than 300 people drawn from all sides of industry and commerce.

Synopsis

1. Has this subject lost sight of its aims?
2. The essence of the subject lies in the importance of capturing data at source in a form immediately usable by the machine. What is the ideal system for this? To read straight from the source document or to translate into machine language first?
3. Reading the documents themselves raises a whole new set of problems relating to their design, imprinting and handling, e.g. the new magnetic ink reading system adopted by the London Clearing Banks.
4. The source of data need not necessarily be a document at all, e.g. DORIS.
5. Whatever the method chosen, the data at the moment of input to the processor should be correct.
6. The problem of data transmission brings comparable problems. Do we want to transmit the source documents, data in machine language or even direct into the computer?
7. The factors governing the choice of a data transmission system are primarily the urgency involved and the volume of data. Comparative costs and reliabilities also enter into the choice.
8. But these problems also have extraneous social and business implications, e.g. cheques must themselves be transmitted right through the Clearing system because the signature authenticates the transaction. How up to date do the up-to-date records for management have to be?
9. Present facilities afforded by the GPO for data transmission, with present speeds and error rates achieved.
10. Circuits were always liable to fail and sporadic bursts of interference to occur and provision must be made against this. The more profitable method appears to be error detection with re-transmission of incorrect data.
11. The results of the GPO survey into data transmission requirements were analysed.
12. On the basis of these returns an assessment was made of the type of circuits likely to be required and the demand appears to be satisfied in the main by existing channels. The error rates required would be obtainable by error detection methods.
13. Some work was described on a basis for comparing the effectiveness of different error-detecting codes and on an audio method of checking data transmission.
14. Terminal equipment and codes were also discussed.
15. It was suggested that all members of an ADP system, both human and machine, should be able to read the same language, though they may not use the same criteria to distinguish the characters.
16. An analysis of style variation in the characters to be read. Do we really need to read handwriting? Is the aim to produce a special-purpose character reader or a peripheral unit to a computer?
17. Methods of character reading could generally be divided into two categories: *cross-correlation* and *auto-correlation*, or they could be divided again into *parallel* and *serial* methods of reading.
18. In *cross-correlation* methods the problem of positional invariance had to be faced and, further, a good deal of redundant information resulted.
19. An *auto-correlation* method was described in which the character was compared with itself, thus rendering its identification independent of position and style.
20. At the moment the impact of computers on documentation was virtually nil although it was the keystone in the communication problem between man and the machine.
21. There was probably no part of the ADP system where the services of the six honest serving men were needed more than in the design of forms.
22. There was also the tendency to revise thinking about the need for some documents altogether, e.g. DORIS.
23. Finally, there was the problem of changeover between old and new forms.
24. A lead from somewhere is necessary before the requisite clarifying of ideas and aims can take place.

The core of this conference might be found in a remark in the discussion following the last paper, a paper which was in the nature of a summary: Has this subject lost sight of its aims? This had been preceded by the deliberately provocative injunction of the last speaker, in which his advice was: Use data transmission if you can't avoid it, use character reading if and when a suitable system becomes available and don't handle documents! The welter of opinion and counter-opinion which led to these cynical statements indicated that progress would appear to depend to a great extent on the clarifying of aims for these three important concomitants of automatic data processing systems.

The essence of the subject lies in the importance of the mode of entry of data into an ADP system although computer output is also affected by these techniques. Ideally this should be captured in machine language at source, or, in some way, it should enter the system in a form immediately usable by machine without further human intervention and the consequent increase in the risk of error. What is the ideal system for this? Do we want to read straight from the source document into the computer, the goal of all character reading systems, or do we want to translate from the document first into machine language, punched paper tape or cards, magnetic tape or any other media which may be proposed in the future? (There is another possibility not mentioned at the conference because it did not come within its terms of reference and this is, the simultaneous production of machine language as a by-product of the original document, e.g. the production by typewriters or accounting machines of punched tape or cards simultaneously with their normal output.)

If we do want to read straight from the source document this raises a new set of problems relating to the design and imprinting of such documents, as well as the problems of handling them, for character recognition and document handling are two subjects which are inextricably mixed. Then there arises the question of whether we wish to read the document as it arises, i.e. to read ordinary printing or handwriting or whether we prefer to encode the document in some way first. The London Clearing Banks, in common with the American Bankers' Association, have chosen the latter course, for their cheques (their source documents) will be printed in magnetic ink characters for later processing by special magnetic ink character reading equipment. Some information will be pre-printed on the cheques before issue while other, such as the amount drawn, must be imprinted in magnetic ink before the cheques can be passed for processing. It is true that the characters used are intelligible to man as arabic characters and numerals but they are in a distorted style (known as the E13B code) specially designed to enable them to be read easily by the machine. The fact that these characters can be read by man is incidental to the actual processing; the Banks have simply preferred to use a code giving this added advantage. If they had not wished to retain this advantage they could equally well have used a code in bars, holes or dots, etc.; if there had been available a fully general-purpose character-reading machine to read both handwriting and print, the banks would not have needed to resort to any code at all.

The source of data need not necessarily be a document: one system was described to the Conference (DORIS—Direct Ordering, Recording and Invoicing System) where the source of data was a telephone call, which was translated straightaway into machine language (punched paper tape) through the medium of push-buttons on a keyboard. In a data transmission system the source of data, as far as the actual computer itself is concerned, is the output from the data transmission system on to tape or cards, or even directly into the computer, as in SABER, the airlines seat reservation system, also described to the conference.

Whatever the method chosen, the problem is that the data at the moment of input to the processor should be correct, or at least adequately checked for its purpose, unless it is possible to devise means for the computer to vet its own input before processing. A character reader must distinguish safely between the characters it is designed to read; any translation of data into machine language must be verified (the advantage of producing machine language as a by-product of other operations is that if the normal output is correct then the by-product must also generally be correct); in DORIS the information recorded by push-button is shown on sight-dials which are read back and checked with the original caller; in a data transmission system there must be safeguards provided against errors which may arise in the course of transmission; and these methods of ensuring the correctness of computer input data are quite apart from conventional methods of ensuring the correctness of the source document or of the data before it becomes a source of computer input.

In a large organisation, there is always a further problem of transmission of data, from branch to branch or branch to headquarters. There are comparable problems here: do we want to transmit the source documents themselves (as the London Clearing Banks do with their cheques); do we want to transmit data in machine language, or is our transmission so urgent, as in the SABER seat reservations system, that we must do it directly without using the media of tape or cards?

These considerations give the clue to the factors governing the choice of a data transmission system; they are primarily the speed involved and the amount of data. If we transmit source documents themselves we use car, train, post, special messenger or facsimile transmission, according to urgency and volume of data. If we transmit data in machine language the same two considerations apply; if the punched paper tape rolls or punched cards are not required for processing until the next day they can equally well be sent overnight by post or train service, but if they are required immediately they can be sent over telegraph circuits or by transceiver; if they contain too great a volume of data to be sent at slow speed by telegraph lines then the telephone network

must be used or even high-speed transmission on broad-band telephone circuits, perhaps adopting a magnetic tape medium instead of punched tape or cards; if the transmission of data is likely to be continuous in nature, private telegraph or telephone circuits may have to be used in preference to the public networks to avoid switching. An example of a system where high-speed transmission for real-time processing was essential was shown again in SABER, where it was laid down that the maximum time interval between interrogation of the central computer at New York and the reply being received on the agent's set was to be 3 secs. Since the distances covered by the system were anything up to 3,500 miles there eventually being 16 telephone lines with up to 900 agents' sets on any one line, and a computer store of some several hundred million characters, this was quite a requirement in equipment and line facilities.

An example of the kind of uninhibited thinking required in these problems was given by one speaker, citing the case of some work that was sent by air to New York and received back in 48 hours after having been processed. The aeroplane proved to be quick, comparatively inexpensive, with an unlimited number of transmission channels! Another speaker dealt with the comparable costs involved and pointed out that a quarter of a million bits on punched paper tape could be sent through the post for 6d! And yet other speakers of the comparable reliabilities. There was no possibility of error in transmission in the post or by messenger but there was possibility of total loss. Doubt was also cast on the whole concept of sending tape and cards to be processed somewhere else. Is another person really in a position to process satisfactorily and with requisite understanding data belonging to someone else's work? It is upon the assessment of the situation in this fashion that the GPO are trying to discover whether their present telecommunications facilities are adequate for data transmission or, if not, what further facilities are required.

But these problems have extraneous social and business implications as well. The London Clearing Banks have adopted a system involving the transmission of cheques since it was essential to the clearing that the signature on the cheque which authenticates the transaction be transmitted from the point of collection to the point of payment; no tape or card transmission system could cover this requirement. It is obvious that for SABER, and for any seat reservation system, immediately available high-speed transmission is essential to give maximum control; the same might apply to some form of stock control, and, in very tight time-schedules, to schemes for payroll, but in general one wonders just how many occasions are there, or will there ever be, when it is essential to send data immediately rather than wait for overnight post or transport, quite apart from the question of comparable costs. A great deal is made nowadays of the value of ADP in providing up-to-date records for management. How up-to-date do these have to be? Up-to-the minute, up-to-the day, up-to-every-two days or only up-to-the week? Out-of-date records certainly imply waste of money but how far the other way does this pendulum have to swing? Only management can answer this, and by answers to such questions as these a clear lead could be given to developments in the three associated fields of Character Recognition, Data Transmission and Document Handling.

Data Transmission Facilities

The opening Session at the Conference was devoted to the activities of the GPO in providing facilities for Data Transmission, both now and in the future, and to surveying the requirements of all computer users and potential computer users in this field. The GPO had a virtual public monopoly in the provision of both line and radio facilities; as far as the former were concerned the user could hire circuit time on the public telegraph or telephone switched networks or they could hire the lines themselves for private point-to-point working. There were also the possibilities of wide-band circuits consisting of an assembly of up to 60, or even more, telephone circuits banded together, giving vastly higher speeds of transmission. The economics of choosing between hiring circuit time and hiring lines were touched on: the break-even point was reached when the use of the line was more than one hour per day for five days in the week.

A considerable amount of information was given on present speeds and error rates achieved with these facilities. It was recognised that data were usually transmitted in blocks of characters and that errors usually came in unpredictable bursts. Consequently in practice what the user wanted to know was how much good time could he expect on a circuit and what percentage of blocks would be successfully transmitted, since in the event of an error it was the whole block that had to be sent again, the larger the block the more data which has to be re-transmitted. The figures on error rates were generally given on this basis for all types of circuits, percentage rates of the order of 98 or 99% being generally achieved. The speed of transmission also affected the error rate for, at high speeds of 1,200 bits/sec., three blocks failed to transmit during tests although they successfully transmitted later at 600 bits/sec.

It had to be recognised also that circuits were always liable to fail and sporadic bursts of interference to occur and that some means of providing against errors must be incorporated into the transmission system. Error-correction always sounded the ideal but in practice the amount of redundant information necessary put up the cost and decreased the efficiency of circuit use; even then it would be practically impossible for a correcting code to cater for all types of errors. A more profitable method would appear to be error-detection with re-transmission of incorrect data, provided this was kept to a minimum. There were two general methods,

still being debated, of achieving this error detection, either through "burst working," i.e. associating redundant bits with blocks of data and retransmitting faulty blocks or through the duplex method using a return supervisory channel to send back received information for comparison with the source. But it had to be borne in mind that bursts of errors were likely to last up to 500 ms. and no amount of error correction or detection would be worthwhile here; some reserve organisation would be necessary to cover such a situation.

The results of the GPO survey into data transmission requirements were incorporated into a paper before the meeting. Every branch of industrial and commercial life was approached, 330 forms altogether being distributed. Of these 92 were not returned; of the 238 that were, 52 stated that they did not require line transmission, whilst 75 answered that it was "too early to say" although 48 of these indicated that more definite information might be available within the next five years. Of the 111 favourable answers only 26 had definite projects at the moment but their replies indicated 125 cases with definite transmission rate requirements. Of these 125 cases, 32% were for telegraph lines and 33% for telephone lines at speeds which can be made available now; another 28% did not quote any particular speed. This leaves a very small proportion of users' requirements for transmission at very high rates, although the replies may have been influenced somewhat by knowledge of what was presently available.

On the basis of these returns and on other statements regarding traffic volume and future intentions, an assessment was made of the type of circuits likely to be required. In respect of the 111 positive returns, 128 requirements were quoted, because some appeared to justify the use of more than one service, with the following result:

Telex	12
Public telephone network	19
Private telegraph circuits	18
Private speech circuits	25
Broad band circuits	3
Not possible to assess	51
	128

On the face of it the demand appears to be satisfied in the main by existing channels. Most replies indicated also that users were satisfied with present media for transmission, paper tape, punched cards or magnetic tape, although the latter would probably become the favoured medium in time. Only six answered that they required to transmit direct to the computer and two of these were for air-line seat reservations, although it could well be that the new interruption facilities in computers might lead to revision of this opinion. Indeed the advent of larger and more flexible computers bringing further possibilities of centralised data processing in their wake, might well revise many of the answers given to this survey. Questions relating to an acceptable error rate drew answers showing that 33% were satisfied with an error rate of 1 alpha character in 100,000, 78% with alpha character rates of 1 in a million or over, while 15% gave no figure at all. These rates, excluding breakdowns, would all be obtainable by error detection methods. Nevertheless there were the remaining 7% who thought they needed an error rate of 1 character in 10,000,000 and at the end of the conference it was suggested that 1 bit in 15 million was a desirable target.

In the next session some work was described which afforded a basis for comparing the effectiveness of different error-detecting codes. Another possible method of checking transmission was demonstrated in the use of a telephone subset to give speech answer-back to the transmitting end; data could be sent in code and returned in speech as an aural check. There were added difficulties of ensuring that data transmitted directly into a computer were accurate; it was even suggested that they should be checked by a smaller computer first before input to the actual processing equipment.

As far as terminal equipment was concerned, it was possible that for use on public networks, certain equipment when available may be made mandatory by the GPO, although manufacturers' equipment was at present being subjected to GPO approval and would probably eventually come into production. A missing link in the present chain of equipment was a low-cost attachment to existing telephones for medium speed transmission. In the USA there existed a range of Dataphone subsets for attachment to an ordinary telephone for the different circumstances of transmission. Of importance also was the question of the codes to be adopted in transmission: the GPO have already agreed that the Telex system could be used for transmitting codes other than the actual standard teleprinter code itself: any 5-unit computer code could now be transmitted over this system. Although the GPO had no plans to change to 8-unit working, now becoming more general for computer input, suitable equipment for these codes could be coupled and if any national or international agreements were made for more than 5-unit working, the GPO would be prepared to adopt these. The GPO may eventually also develop suitable error-detecting equipment.

Character Recognition

Character recognition is a subject on which a lot has been said and written and little achieved. It interests a wide variety of people from bankers to researchers on the human brain and it is of fundamental importance in computer input.

In the same way that all members of staff should ideally speak the same language so all members of an ADP system, both human and machine, should be able to read the same language. This does not mean that man and the machine should use the same criteria to distinguish the different characters: each might use

different facets for recognition (in fact it was open to doubt as to how human beings actually recognise characters). In searching for this common language, there was no particular reason why these two sets of criteria should even be incorporated into the same shape, as long as they were associated together, i.e. 5, where man recognises the figure and the machine the code. There was no strong argument against this idea even though most work in character recognition was devoted to devising machines to read exactly the same shapes as man. It will be remembered that the Banks have adopted a magnetic ink character reading system in which this latter principle obtains, with the result that the actual characters are singularly distorted to enable both the human eye and the machine to read them.

There were two sides to this work: actually obtaining the signals off the paper and the analysis of style variation to enable characters to be distinguished. There were various categories of style which could be read, these ranging from specified type founts only to any printed matter and ultimately to handwriting, for both alpha and numeric characters, the final stage being a completely general system for reading alphabet and numerals, however recorded. This raises again the question of aims for this subject: do we really *need* to read handwriting? A system where the characters to be read were already specialised and standard, and on a form standardised in size, would perhaps imply a greater control over the automatic data processing system as a whole. However, the cost of having a general character reader, should one ever be developed, might even be far outweighed in some cases by the cost of changing all the relevant documents to a standard specialised style. Finally, is the aim to produce a special-purpose character reader with its own form of output on to tape or cards, etc., or is it to provide an on-line peripheral unit for computers?

Characters differ in many ways, in size, in kind and in combination. Many methods have already been proposed for ascertaining these features which would lead to the identification of characters. They could generally be divided into two categories which could be called *cross-correlation* and *auto-correlation*. In the former, characters were identified by comparing them with known patterns already in store; in the latter they were identified by comparing them with themselves!

The best known of the first category, described to the conference in a paper, was the Solartron ERA, in which a matrix was superimposed upon the character, the distribution of black in each square of the matrix being determined. From these differing intensities the features of the character could be deduced for comparison with features of known characters contained in the store.

Another cross-correlation method was described for character recognition by digital computer using a Special Flying Spot Scanner, but this method could be distinguished from the matrix method by calling it serial instead of parallel. In a parallel method all parts of the character are scanned together (as they probably are by the human eye); in a serial method, consecutively. This Special Scanner scans the character vertically in sections, the information from each vertical scanning line being then transmitted to the computer, where it is interpreted to produce a description of the character in terms of its length, slope and curvature features and their relative positions. This list of features is then compared with those already stored describing the standard characters.

In both these methods the problem of positional invariance had to be faced, i.e. finding the actual position of the character before it could be processed, although it was more difficult to position a parallel device than a serial one. In fact the view was expressed that the true difficulty lay not in recognising the characters but in actually moving the documents around. In both methods also a good deal of redundant information was obtained which did not lead to ease in discrimination. Both these machines would respond to any shape placed in front of them and try to identify it, i.e. they are very general systems. A safer way would be to devise a system for recognising only those features which were unique to the character being analysed and further to devise equipment which responded to these features and to no other. The topological features of the characters which would need to be analysed to find this "uniqueness" were lines and curvatures and their position in relation to each other. This "uniqueness" would appear to differ for the range of characters one wished to identify, for example, it would presumably have to be more refined for a range which included both letters and figures, than for a short range of figures only. An advance decision would have to be taken on the set of characters to be recognised and a device made to recognise only their characteristics, nevertheless this method would obviate the need for so much redundancy of information. Two alternatives to having to make such an advance decision were put forward: one was the possible use in the future of learning machines for discovering and optimising the criteria to be used in recognition and the other the use of a changeable store in the computer according to the set of criteria involved.

A new technique was described for the recognition of written numerals which was based on these lines of thinking. It was an auto-correlation method since it compared the character with itself. This rendered the identification of the character independent of its position and indeed of its style. The character was reflected back on to itself at a fixed distance of displacement but varying in direction, the actual identification being performed through the study of the resulting waveforms. Usually this was a 2-term displacement, but waveforms could be further defined by making it a 3-term displacement. Another refinement was to scan the character and its reflection through three separate zones but this had the disadvantage that the independence of position was then lost.

Document Handling

The first speaker on this subject took as his theme the *potential* impact of computers on documentation, for while the advent of computers was bound to bring about changes in documentation, at the moment the impact was virtually nil. Has any firm yet changed one of its documents as a result of a computer application? It was doubtful. The net result so far has been to increase the volume of paper work to mass production proportions but not to change the design of documents.

Nevertheless it was a very important subject, the keystone of the communication problem between man and machine, in fact, and greatly affected by present and future developments in character-reading, by the place of the document itself in the ADP system, by whether it has to be readable by both men and machines or only by the one and not the other, by concepts such as management by exception where the final output documents may be reduced to a minimum, by whether the document is internal or external, i.e. whether it has to go outside the firm or not, and many other considerations. In fact there is probably no part of the ADP system where the services of the proverbial six honest serving men are needed more than in this sphere of the design of forms. What is the exact amount of information we wish to give? How is it to be recorded? When is it to be checked? Above all there must be no unintentional bias conveyed by the design. Those engaged in Market Research were probably the experts in the field although a very useful booklet was available from the Treasury on "The Design of Forms." Nevertheless in anticipating such changes it was suggested that to distort present forms or typescript to adapt them to computers, as the London Clearing Banks intended to do with the characters on their cheques, was entirely the wrong approach.

Furthermore, the mechanisation or automating of systems certainly tended to revise one's thinking about the need for some documents altogether. The designers of DORIS (Direct Ordering, Recording and Invoicing System) had eliminated the stage where the order was written down before being processed and fulfilled by simply proceeding direct from telephone call to punched paper tape, via a push-button keyboard, because they had first realised that 85% of their customers gave their orders by telephone and not in writing, at a manageable rate of approximately 150 orders a day. But in the banking world the problem admitted of no such neat solution for their system was an open one with the customers themselves producing the original documents (cheques) to the tune of something like one million cheques a day. This document was necessary throughout the processing and means of adapting it to mechanical handling had to be devised, whilst retaining its present all-important security features.

Finally, even after new forms were designed, there was always the problem of the changeover, well illustrated again by the banking system: what policy were they going to adopt to introduce the new cheques with magnetic ink imprinting when the old style cheques were still extant?

Conclusion

Automatic Data Processing was described in the course of the conference as an aggregate of machinery for performing the processing of data in a business, but the establishing of successful systems incorporating machinery apt for its purpose depends upon first having clear basic aims. How involved are the considerations to be taken into account was revealed by the papers and discussion, so involved in fact that very, very few have been willing to pioneer these new systems and take the necessary risks. All sides are calling for a lead: industry is demanding it from the Government and the Government from the heads of industry but a lead from somewhere is necessary since the requisite clarifying of ideas and aims may not occur until there is sufficient working experience to study and from which to draw conclusions.

Fort Dunlop

The *Dunlop Rubber Company* has ordered a LEO III Automatic Office for installation at Fort Dunlop, Birmingham, next year.

LEO's first task at Fort Dunlop will be to produce invoices and accounts for the vast tyre replacement market. This covers 5,000 orders each day for a range of 30,000 items. Soon afterwards, it will deal with supplies to vehicle manufacturers as well. At the same time, LEO will prepare all sales statistics.

Second Computer installed at Austin Motor Company

An EMIDEC 1100 data processing system, supplied in the summer of 1960 by *EMI Electronics Ltd.*, is now in full operation at British Motor Corporation's Longbridge factory —claimed to be the most highly mechanised motor plant in Europe. This is the second EMI computer now working at Longbridge. It will handle sales invoicing, sales accounting, receipt and analysis of orders, production schedules, sales statistics and stock analysis.

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CORRESPONDENCE

Algol

Sir,

May I, in fairness to all concerned, ask you to inform your readers of a sequel to my article on "The Automation of an Election"? Our Social Club runs in two relatively autonomous divisions corresponding to two sites, and the article gave rise to some argument between the divisions, from which it ultimately transpired, to our surprise, that whereas we were basing our practice on a pamphlet issued by the Proportional Representation Society in 1920, the other division was using the Irish Senates (Proportional Representation) Order 1921, and that the procedures are not identical.

The procedure laid down in the Irish Senates Order resembles much more closely the ALGOL procedure in my article, and is in fact free from the objections discussed in the article.

Yours, etc.
BRYAN HIGMAN

Windy Sayles,
Felden,
Hemel Hempstead.

THE SELECTION AND TRAINING OF COMPUTER PERSONNEL

Discussion Meeting of the Society held at Northampton College of Advanced Technology London, in November 1960

Reported by Dudley Hooper

One of the first tasks of the Society's Education Committee was to consider the desirability of introducing some form of examination for different types of people working with computers. They had in mind particularly three types of personnel: Maintenance Engineers, Programmers and Operators.

It was soon realised, however, that conditions of employment, the duties and experience expected of operators and programmers, for instance, varied a great deal. It was difficult to know whether it was possible to prepare syllabuses which would be generally useful, or whether it was worthwhile to approach some other body to provide the examinations. The Committee felt that many of the questions involved could best be ventilated at a discussion meeting, at which those interested in the running of computers would be free to express their opinions.

The proceedings were considered to be a private meeting of the Society, and no press representatives were present. Apart from the invited speakers, the names of those contributing to the discussion are not quoted in this report.

COMPUTER PERSONNEL

Dr. R. A. Buckingham (*University of London Computer Unit*, and a Member of Council) introduced the Discussion Meeting by focusing attention on the types of personnel involved in the use of computers. The chart (reproduced opposite) ignores those concerned in designing and manufacturing computers.

At the top there are a number of groups who are mainly interested in applications of computers. These include systems analysts, mainly concerned with commercial and industrial applications; applied scientists, such as engineers, perhaps economists; pure scientists, such as chemists and physicists; and "creative" programmers, such as those who are developing a new autocode system or inventing new techniques for using the computer. For these four groups the use of computers is but one aspect of their training, and programming is a means to an end.

In the lower half of the diagram are recognisable categories of more immediate concern to the meeting. Their whole career may be concerned with computers; how should they be selected and trained for their job? They include operators who may perhaps in the course of time become coders; technicians, who may develop into maintenance or installation engineers; supervisors, both on the technical and applications side, who may be recruited from any of these groups; and programmers and coders.

"You may or not agree with me that a progammer pure and simple is a very rare animal. I am inclined to compare him with a Yeti—you see his footprints everywhere, but when you track him down he is either a mountain rabbit or a blue bear or something else. I hope we shall not spend too much time at this meeting trying to define the indefinable. My diagram may have oversimplified the actual situation, but what I hope it has done is to pick out some of the recognisable types who are appearing in the computer field."

He suggested that there were a number of relevant questions (and not just rhetorical ones) which should be asked:

Can aptitude tests play a useful part in the selection of personnel?
Would selection be assisted by examination courses leading to preliminary qualifications?
Can useful courses in programming or data processing be devised which are not directed to a particular computer?
Are different programming courses essential for commercial and scientific/engineering users?
Can courses on computers and programming be introduced into the curriculum of Technical Schools?

FUTURE NEEDS

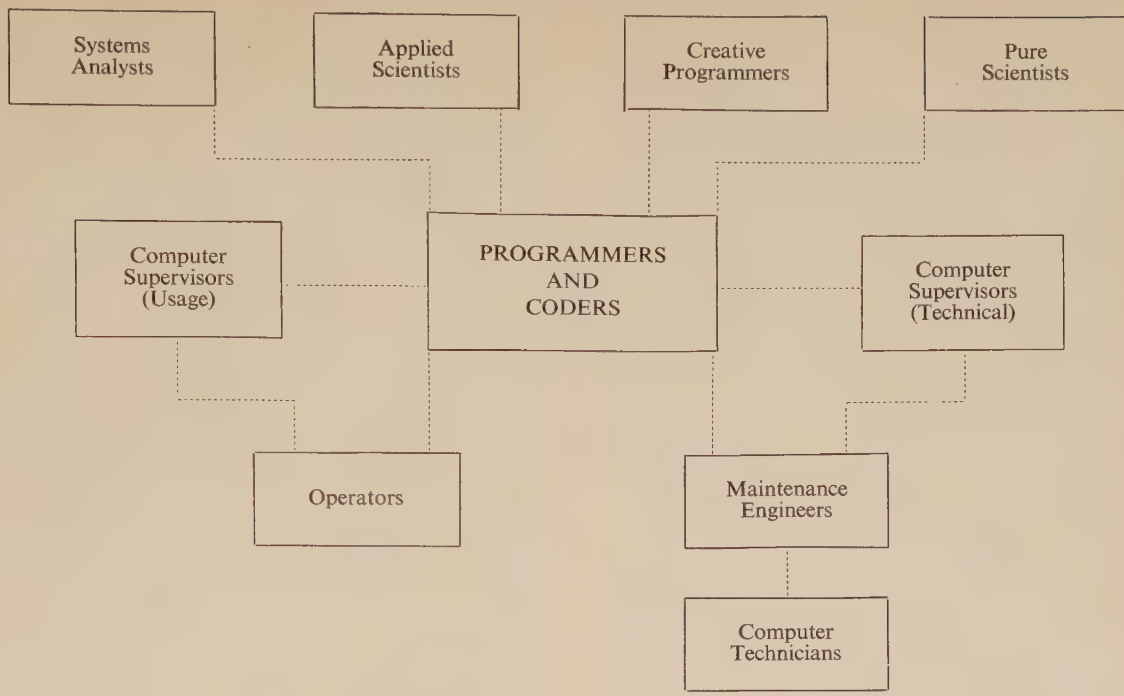
Turning to some of the problems which lie ahead as the use of computers develops in the UK, Dr. Buckingham referred to experience in the United States, quoting a survey of government data processing installations covering 237 computers and 4,000 personnel. An average of about 16 personnel are employed with each computer, excluding maintenance engineers, or 18 allowing for posts authorised but not filled. With some large installations (e.g. of IBM 705 or UNIVAC I) the average is near 50. Detailed analysis gives the following breakdown:

8% computer administrators,
48% programmers (of all types),
16% computer systems operators,
9% peripheral equipment operators,
3% electronic technicians, and
16% systems analysts.

No account is taken here of associated occupations (mathematicians, accountants, etc.)

A recent survey in the UK on the commercial use of computers stated that 180 were in use a short time ago (1960), compared with 3,860 in America. The rate of increase in UK has been 50 a year, but may rise to 150 a year by 1962. "When there are 1,000 computers in UK and if we can

COMPUTER PERSONNEL



accept the American figures, we shall require, in round figures:

1,500 supervisors,
9,000 programmers and coders,
4,500 operators,
500 technicians, and
3,000 systems analysts.

To these figures should probably be added 3,000 or more maintenance engineers, and large numbers in the ancillary occupations I have mentioned.

"I imagine that the personnel at present employed number somewhere between 3,000 and 5,000, and hence, making a reasonable allowance for turnover, wastage and other causes of loss, we must provide for the training during the next few years of a computer force in excess of 20,000.

"How soon may this level of 1,000 computers in Britain be reached? Ten years is almost certainly too long; 5 years perhaps too short. My own guess is that it will be between 5 and 7 years.

"I realise that the numbers I have given are very approximate. Nevertheless they do show, I hope, that in inviting you to this Symposium and asking you to contribute to the discussions we have a very serious purpose in mind. The selection and especially the training of computer personnel is going to be a big task, which must be widely spread. I have no doubt that a considerable part of it should and will fall on universities and technical colleges (this is recognised also in the American report I have mentioned) and it follows that they should be adequately equipped and staffed for the job."

* * *

COMPUTER PERSONNEL IN THE US

The status of computer personnel in the United States was dealt with by Mr. A. S. Heitz (*NCR Electronics, Dayton, Ohio*). He defined "professional status" in the US as "widespread recognition through achievement on a scientifically organised scale."

"You and I know that there is no substitute for experience in the EDP art and science. One cannot just read books and join the fraternity. One must 'intern' with an installation before one goes on his own. However, 'computing operations' in their various aspects in the US *are* an established profession. There are 'numerous Civil Service classifications and many companies *have* job classifications written for computer personnel. These classifications in themselves spell out professional qualities not easily achieved. The income levels which are offered, from Systems Designer to Systems Analyst down to EDP operators, are enough to attract well qualified people. It is more of a problem to keep unqualified people out.' "

In the US Government there are published job classifications for EDP. A person can start as high or higher in salary with the Government though perhaps not *ultimately* go as high in salary or as quickly as in industry. In the Government, a university graduate can start at about £2,150 per annum. If there are positions available, those graduates who finish in the top 10% of their class can begin at about £2,570 per annum. A coder would begin at something around £1,700 per year. The whole range of positions from Programmer to Systems Analyst through Section Supervisor, Branch Supervisor, Division Supervisor and sub-cabinet rank are well-defined. The top salary scale before congressional approval is required is £8,000 for a Divisional Supervisor. In industry the scale is lower at the beginning and in the middle because there is less requirement for scientifically trained personnel.

The Government requires its personnel, to a great extent,

to be somewhat scientifically orientated. They use research programmers to do business programming, for example. Their job responsibilities include both Systems Analysis and Problem Definition. The use of scientifically trained people in this respect by industry is usually limited to only the very large companies. A person out of the University three to five years, with good computer experience, will earn about £3,000 per annum in industry. The average person with a mathematics or engineering degree who is not in EDP will be earning a bit less over the same period of time and have future prospects which are not quite as bright as the one in EDP.

Almost anyone can join a number of professional bodies if he or she pays the annual dues. However, active participation in any one of these organisations will be limited to those who by education or experience are capable of understanding what is being discussed. "Perhaps one day there will be a qualification-controlled organisation which will be limited to professionally qualified people, but there is no such organisation in sight at the moment."

"With the demand for well-qualified people in this new art and with no saturation point in sight, I can think of no greater incentive to achieving professional standing. The more people at work at the user's level, the greater the need for perhaps the most skilful scientists we have ever had at the top, whether it be in systems or development effort. As the demand for EDP operating personnel increases, lower proficiency standards at that level may be necessary. This again increases the need for highly skilled scientists in both design specifications and the creation of automatic programming systems. All of these premises, you will notice, are business-orientated. There is no implication that scientific computing can be achieved without proper scientific training and education."

* * *

MAINTENANCE ENGINEERS

Mr. G. H. Hinds (*British Transport Commission*, and Member of Council) introduced the session on the selection and training of computer maintenance engineers. He emphasised that he was not dealing with manual skills, which could only be acquired by actual practice, or maintenance training for a particular machine, which was best done by the manufacturer. There remained, however, an essential theoretical background.

But it is necessary to remember that after he has done his preventive maintenance and repair work, he is a "fire brigade," there if needed in emergency. If over-qualified he will get bored, or will try out unofficial modifications to the equipment. Ordinary National Certificate level seems to be about right.

Computer maintenance work covers electrical, electronic and mechanical engineering, and cuts across established fields. The nearest parallel in the sort of training required is in telecommunications and radar work. The most important part of the job is fault diagnosis. Close co-operation with operator and programmer is essential.

Since the first symptom of a fault is seen by the operator, the first task is to translate operator jargon into circuitry jargon; the maintenance engineer must therefore learn the former. Developing this need for understanding of other techniques by the engineer, Mr. Hinds summarised the training needs as:

(*a*) A good knowledge of the basic principles and logic of computer design and operation;
(*b*) Some understanding of mechanical methods;
(*c*) A sound knowledge of computer programming, including the use of autocodes and concurrent operation;
(*d*) The ability to keep records; and
(*e*) Some appreciation of the statistics of reliability.

* * *

PERSONAL QUALITIES

The second speaker on maintenance engineers was Mr. R. E. Hodgkinson (*Ferranti Ltd.*). Endorsing the technical skills outlined by Mr. Hinds, he went on to deal with the personal qualities required, referring particularly to the maintenance of a medium or small machine by one man.

"Personally he must be self-confident and reliable so that he can be trusted to work efficiently and conscientiously with a minimum of supervision. He must possess initiative to employ his technical knowledge effectively, but he must also exercise restraint. The enthusiast who redesigns the machine to cure a fault is of no use to a maintenance organisation.

"Our ideal engineer must also be systematic in his work, keeping proper records and making accurate reports. At the same time he must not be slow and plodding; a sense of urgency is most important. Computer time is valuable and must not be wasted either by laxness or panic on the engineer's part when faults occur. Lastly, but probably the most important, he must be able to get along with other people, presenting his own point of view firmly yet tactfully and sympathetically. There is little danger of our ideal man materialising!"

On recruitment, Mr. Hodgkinson stressed the difficulties in a new industry without an established and experienced labour force to draw upon. The perpetual shortage of suitable people can only be met by recuiting the best available material and training them *ab initio*.

"They come to us from the universities, the technical branches of the armed services and the electronics industry. A cross-section of the senior engineers on my own staff shows that recruits from all of these sources have been successful. The university graduates may have trained as either engineers or mathematicians. Many of them spend about two years in the field before going on to development or commissioning work. Yet a university degree is no guarantee of success or that a man is suited to computer maintenance. Fortunately we have had few failures over the past ten years, but two cases were honours graduates.

"At their interviews all applicants are first tested on their theoretical knowledge of computer type circuitry and ability to understand the principles of logical elements. Most new recruits come with engineering backgrounds, which means that even after their training they tend to be weak on programming.

"Personality is still more important than technical ability in most jobs. Anyone possessing both is not very readily

attracted to work which often entails working shifts or other domestic inconveniences. Certainly one can understand a newly graduated engineer preferring to work in a laboratory where he has comfortable hours and answers to a technical man who appreciates his difficulties instead of a customer who, having spent a great deal of money, expects results, not explanations."

Recruitment and training is expensive; it is six to nine months before a man can be employed in the field. Mr. Hodgkinson favoured the tutorial method of training. Two months are first devoted to the theory of logical design of a particular type of computer. Then practical instruction on operation is added. Finally he helps to commission a machine in the factory.

"In this country we have never yet dealt adequately with the problems of training high grade technicians on a large scale. It seems to me that much of the trouble starts through the emphasis which is placed on the grammar schools as the most desirable form of secondary education. If a boy can get through grammar school to a university there is encouragement for him to enter the many technical fields open to him. If he does not go to a university I think that he is much more likely to seek a career in commerce rather than in industry. For this reason I would like to see more youngsters encouraged towards technical education, particularly where they have an aptitude for that type of work. Although the employers will need to co-operate by making openings for them to enter industry with the prospect of advancement on a staff basis, it is still initially up to the education authorities to elevate the status of secondary technical schools in the public mind so that they attract promising youngsters. Similarly more should be done to provide comprehensive evening school courses in subjects such as electronics. Outside of London and a few major provincial centres this type of instruction is non-existent.

"During the past decade we have really gone through two generations of computers and we are shortly going to have to look after the third, the time-sharing machine. This is more complex in its logical design, requiring greater emphasis on that side of the maintenance engineer's training and aptitude. At the same time the number of computers in the field is rapidly increasing, requiring in turn a commensurate increase in the numbers of engineers properly trained to look after them. If this demand is to be met properly there must be a much greater degree of co-operation between everyone interested in operational computers and the authorities responsible for technical education in this country than has so far been the case."

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DISCUSSION

In the discussion that followed, many speakers emphasised again the points made by the main speakers. One question raised was the opportunity for advancement if initial recruits are only at the level of qualification of Ordinary National Certificate. It is to be hoped that there would be opportunities for advancement within the organisation, particularly with larger installations, but another speaker pointed out that this underlined the difference between a user maintaining his own machines and these being looked after by the manufacturer, the latter having more scope for the advancement of engineers. At the same time, there is no reason why a maintenance engineer should not move on to more responsible work after two or three years.

This raised a further question as to whether engineers should also be operators, which would avoid the engineer having idle periods, as had been suggested; while he would also have more interest in his work. A further advantage would seem to be that there would be less dispute between engineer and operator during diagnosis of a fault. It was generally felt, however, that it would be difficult politically to combine a technical and non-technical job, while another speaker emphasised that the engineer does not necessarily do nothing when he is not actually working on a machine; there are repairs to be carried out on units of equipment removed for that purpose, he has his reporting to do and records of faults to maintain, and usually he would be responsible for a fair range of stocks of spares. It was felt that this situation of one person combining the two jobs would be the exception and it was not generally advocated. The position might be more likely to arise with larger installations where there were a number of engineers, working probably at more than one level. With time, the position might develop so that there were both technicians and also engineers/mathematicians.

Some doubt was expressed as to whether young people, if the aim was to recruit at a fairly young age, would have the necessary personal qualifications which had been stressed by earlier speakers. Experience in America had shown that they should not normally go out into the field until they were 24 or 25. In general, it was considered that the computer field was so wide and the need for technicians so great that recruits should be obtained as young as possible, and that Ordinary National Certificate level was sufficient. There was no need to lay down more difficult qualifications. So far as one could see ahead, prospects for promotion, and for changing into other technical aspects of the computer field, appeared to be sufficiently good to encourage young entrants.

SELECTION TECHNIQUES FOR PROGRAMMERS

Opening the afternoon session of the Conference, Dr. H. G. ApSimon (*IBM Ltd.*) first described, so as to define the work of a programmer, the eight steps required to find the solution for any problem involving a computer.

1. Statement of the problem in the language of its own field.
2. Statement of the problem in mathematical terms.
3. "Solution" of the problem in terms of a set of equations representing the rules of decision (= main block diagram).
4. Detailed block diagram.
5. Problem in a program-oriented language, or a machine-oriented language.
6. Tested machine language program.
7. Results obtained from the computer in numerical form.
8. Results in the original language of the problem.

He suggested that the functions of a programmer were steps 4 to 6 above, although the best programmers (who

would also be something of mathematicians) would cover steps 2 to 6, and it was with these that he was concerned.

Training must therefore include a good relevant mathematical grounding. Much of this could be done as part of a proper applied mathematical course at a University, although he considered that much present university training was inadequate—numerical analysis should be included.

In selecting the right people as potential programmers it is necessary not only to establish their knowledge, but also how much effort has been put into increasing this. Personal suitability is most important; a programmer must be enthusiastic, a good mixer, of an analytical turn of mind, logical, accurate, imaginative, persistent, and able to carry on steady work under pressure. *IBM* consider that many of the qualities can be established by an aptitude test (this is not an intelligence test).

He gave samples of the results obtained from a number of these tests as a measure of their effectiveness, and compared these with later class markings and examination results of the same individuals. The results were well correlated and showed that the tests had been useful.

In actual training of programmers, Dr. ApSimon said that a 7- to 8-week period learning machine principles was necessary before going on to programming. While he considered that a very thorough basic training was essential, programming, like playing a musical instrument, is essentially a self-taught technique. At present the whole training, which with *IBM* takes up to 6 months depending on the individual, has most emphasis on coding, and he felt that numerical analysis should be added to a programmer's basic skills.

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PROGRAMMER SELECTION AND TRAINING IN US

Some American experience and practice in the selection and training of programmers was described by Mr. A. S. Heitz (*NCR Electronics*), who suggested that "never before has so much complex training been given to so many with so little current equipment available."

Historically, the selection of computer personnel began with mathematicians, because scientific computation began well in advance of commercial data processing. But then several things happened:

1. Many mathematicians did not adapt well to or lost interest in the practical side of business problems.
2. Mathematicians became increasingly expensive and their employment even then became unstable.
3. The decision makers in management had difficulty in communicating with them.
4. The methods man/mathematician team idea evolved.

"Once EDP users decided that it was more practical to teach their own people to program than to teach all the parameters of their business problems to a staff of mathematicians, the problem of personnel selection became a reality. The first and obvious course was to find a correlation in one or more existing aptitude tests. Our Company spent a large amount of time and money in this direction. No one seemed to have a test that gave a sufficiently high correlation on successful programmers as well as unsuccessful programmers. One of the necessary qualities which was not tested was patience.

"Then our manager of computer education and one of our top system analysts started with an entirely new approach. They devised a test which guides an applicant through a series of actual programming problems. Their statistical comparison with known qualities proved it to have good bi-modal curves, showing two distinct populations—those who could program and those who could not, with a minimal grey area in between."

There are eleven problems. Seven or more correct answers indicate a qualified applicant. The applicant's systems knowledge must be judged by interview. An hour and a half is generally allowed as sufficient time. Failure to complete the test in that time or achieve an acceptable score is considered to be an indicator. Generally speaking, the fear that capable people could not be obtained has disappeared in the US.

Most of the training of computer personnel in US is provided by the computer manufacturers. The courses last from two days to five weeks, depending on their range.

The universities are playing an increasingly active role in computer education. There are nearly 100 computers installed in universities, and many more on order, and all are used for teaching purposes in one way or another. Because of the amount of operating experience obtained, the quality of this educational source is high. Most university EDP systems operate around the clock. The US best known Correspondence School also teaches a course in computer programming.

Advanced degrees in Electronic Data Processing are available at several universities.

There is also the extremely important area of Executive Education. "An EDP system is only as good as the people who plan and operate it. These same people are only as effective as their top management liaison is well-established. Thus, a good, thorough understanding at the executive level is essential. We encourage top management to learn programming and many have done so."

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APTITUDE TESTS

The last speaker in this session was Mr. E. A. Newman (National Physical Laboratory). He had been concerned in examining a wide range of selection techniques for computer personnel, and emphasised that there is a vital difference between commercial, or business, programming and mathematical programming. In connection with Civil Service recuitment, where sifting of raw material was essential, they had tried *IBM* aptitude tests, University entrance tests, Standard IQ tests, and some tests devised by the Civil Service Commission, one of which is very similar to those described by the previous speaker.

Between the different sorts of tests a remarkable degree of correlation has been found. A similar correlation has also been shown between IQ and Aptitude tests, and he was of the opinion that there was little difference between them.

From this he concluded that anyone who is good at an IQ test is generally good at any test, and probably a good programmer, although not necessarily so. It has been found, however, that failure on an IQ test does not necessarily mean that the individual would not be a good programmer; two of their best programmers, particularly where the program was long and involved, had actually done badly on their tests. He concluded that aptitude tests would show up coders but not the really good creative programmers, who would develop later.

* * *

DISCUSSION

Wide interest in the various forms of aptitude tests was shown by the discussion that followed, although in the main this was confined to a series of questions to the three speakers. Dr. ApSimon agreed that there was some divergence between himself and Mr. Heitz on the qualifications needed of a good programmer; this was in the main due to the distinction, which he accepted, between scientific and commercial programs. If one has team work on one problem this involves in turn communication problems between those concerned, and he believed that one man should do the whole job, in preference to Mr. Heitz's "methods man/mathematician team" idea. He agreed that programs vary in complexity, and that programmers under training could be used for the simpler problems.

The *IBM* two to three months' training in programming is mainly in classes, normally of 10 or 12 with an upper limit of 20. They work shorter hours than normal working hours but have an appreciable amount of homework. Three weeks are spent on actual programming and coding, two types of machine being covered very thoroughly. He did not think that auto-codes would have any influence on selection tests in the future; they only reduce clerical work but programmers will require the same abilities as those for which the present tests are designed.

Mr. Heitz agreed that there is a difference between scientific and business programming and expressed the opinion that high intelligence with low programming aptitude is sometimes found because the highly intelligent person reads too much into the problem. Asked how the *NCR* tests covered the qualities of patience and perseverance, he suggested that the eleven tests covering 1½ hours in themselves prove these qualities. On the introduction of auto-codes, he did not think these would have any influence on selection tests, as they are still no substitute for learning a basic machine language. One questioner asked how much training was given to those interviewing potential programmers; this, Mr. Heitz said, comes from professional experience and no training is in fact given.

Mr. Newman was questioned concerning the two programmers to which he had referred, both of whom did badly on their tests. One was a really good electronics engineer, who first showed aptitude in computer design and then became ingenious at programming; the other had done uniformly badly on every test. One speaker suggested that there is little place for a "pure" programmer on the commercial side, and asked how a systems analyst should be chosen; should he also be a good programmer? Mr. Newman said that a systems analyst must be able to do everything, systems work and programming, but there is still a place for a pure programmer. On the length of time that any particular series of tests should remain in use, he agreed that they must not be protracted, and would probably need revising every two years at least.

TRAINING IN UNIVERSITIES AND TECHNICAL COLLEGES

Mr. M. Bridger (*Leicester College of Technology*) reviewed the existing courses in Technical Colleges and Universities of interest to computer operators, programmers and numerical analysts. He emphasised that this was not a complete survey but based on a sample. Academically these courses demand a prior standard of knowledge at anything from GCE ordinary level up to postgraduate standard; the courses may be full time or part time, day or evening. They can cater deliberately for the computer field (obviously *the* feature of the manufacturers' courses) or only incidentally (e.g. as part of a wider training involving electronics and numerical methods). There are also many *ad hoc* courses, usually run by Technical Colleges in the evenings, or at summer schools by both Technical Colleges and Universities; these cover computer appreciation, engineering, design, programming, numerical analysis, or a mixture of any of these. The range of subjects could be seen from lists of available courses published in recent issues of *The Computer Bulletin*.

Reviewing the academic courses offered at present by Technical Colleges, Mr. Bridger first referred to the part-time day course available in several Technical Colleges on computing, recognised by the Associated Examining Board, for GCE advanced level in Mathematics with Computing. This gave a useful background, but it was limited to hand computing and arithmetical methods, although it could be extended to digital electronic computing. A most interesting development was a part-time three-year course offered by some half-dozen Technical Colleges in numerical analysis and programming, with entrants at GCE "A" level or equivalent. This provided specific computer training including auto-code and the detailed study of one electronic computer. A full-time four-year sandwich course was offered by several Technical Colleges for a diploma in applied mathematics. This included computing methods, numerical analysis, logical design, and a special project, such as the detailed study of a particular digital computer and construction of a major program. Details of the syllabus of this and the previous courses referred to were circulated to the Conference.

Turning to the work of Universities, it seems that the available courses in the extra-mural field are particularly valuable, especially in programming. Full-time degree courses, such as for mathematics, physics and engineering sometimes include numerical analysis (although this is often optional) and occasionally some programming (also optional). In the post-graduate field a one-year diploma course is offered by Cambridge, Durham, Leeds and London, which includes

some data processing and business applications. Several Universities also offer a number of part-time courses, mostly in programming for particular machines.

There is, Mr. Bridger admitted, a bias in academic courses towards the technical side. Systems and commercial data processing requirements are not being catered for.

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SOME SPECIAL COURSES

Mr. J. W. Wright (*Manchester College of Technology*) described the courses, including a number of special ones, arranged by the Manchester College of Technology and College of Commerce. Together these courses showed a wide range of development, and many were designed to deal with computer appreciation and data processing.

The Manchester College of Commerce has been running appreciation courses (mostly in the evenings) since 1956. Recently they ran a residential course especially for senior executives of British Transport Commission. The College of Technology runs a variety of courses, from four to ten weeks, while many Departments of the College now have lectures on computers in their normal syllabus. About 2,000 degree students are now given lectures which refer to the use and application of computers. There are also extra-mural classes for junior and middle management.

Two special courses were of interest. The first, a ten-week course, later reduced to six weeks, was arranged for the Royal Army Pay Corps. Begun in 1957, there had been four of these courses although the actual computer to be used was not then known. It is preceded by basic *IBM* punched card training. The other special course was the one referred to above arrranged for the British Transport Commission. This was aimed to teach the method of making a feasibility study, evaluating manufacturers' proposals and making a detailed systems study; programming was not included. The course was staffed partly by the college and partly by manufacturers, using several of them.

Commenting on the experience gained from the courses, Mr. Wright stressed the need for some introductory work on mathematics, bringing in numerical analysis, statistics and simulation. There was then need for an introduction to programming, with a description of a particular machine as an example. Basic arithmetic work should be programmed, leading on to some simple commercial examples, such as updating files.

Use of an auto-code was a help in training. In his experience students were able to write a program after six hours' tuition in auto-code.

The most difficult part in training was in the field of specific application. He felt that a systems analyst could really only be trained by practical work under discipline. For this to be realistic, Colleges must have access to the work actually done in the field by users.

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WORK OF N.C.A.T.

Mr. L. T. G. Clarke (*Northampton College of Advanced Technology*) reviewed the work of the college over the past 10 years. In 1950 there was an evening course entitled Computations, for postgraduate engineering and science students, which dealt with basic numerical methods and included some practical work on a few desk machines. By 1952 there were several evening courses, on analogue computing, numerical calculus and programming for the three machines then available, EDSAC, the pilot ACE and the Manchester University Computer.

"Since these early lectures there has been an ever-changing series of lectures on various topics. At present we have eight evening courses varying from Algol and Cobol on Mondays to an Elementary Introduction on Thursdays. Computing for Civil Engineers is a course in which graduates of the civil engineering profession are invited to bring their own problems and learn to put them on a computer. Courses in numerical analysis are now run for the London University Diploma which started in 1957.

"Turning to the day classes it must be appreciated that students today enter this College with qualifications at Advanced Level GCE, and are subject to selection. There is therefore reasonable hope that they progress a good way towards graduate status.

"In 1954 we were running classes for the Higher National Certificate. These had to be run in conjunction with the Institute of Physics as no other suitable body was then in existence. These courses eventually faded out due partly to our upgrading to a College of Advanced Technology and partly to the large amount of physics and the small amount of numerical analysis and mathematics included in the courses.

"However, the need for an award at this level was so great that efforts were made to introduce and develop a course of similar standard with a strong bias towards numerical analysis, computing and statistics."

In 1955 the Associated Examining Board held its first examination in Computations. In 1957 sandwich courses began in Applied Mathematics; the syllabus includes numerical analysis, analogue and digital computing, mathematics and a special project. In July of that year the College took delivery of a PEGASUS computer. In 1958 a G-PAC analogue computer was purchased. Students now have practical training in programming for both analogue and digital computers.

From time to time special courses have been held on programming, data processing and numerical analysis.

Full-time degree students have not yet been able to devote much time to computing, but it is hoped that second year students will attend programming lectures in auto-code.

"During these ten years we have had a number of difficulties. I have recorded a few as they occurred to me:

(*a*) Establishing a correct balance between vocational and non-vocational training;
(*b*) correctly assessing the ability of a student when the equipment used varies greatly;
(*c*) teaching older students who have not studied at college for some time;
(*d*) deciding on a course which can be common to students with different backgrounds;
(*e*) obtaining a correct balance between theory and practice;
(*f*) deciding on a broad course studying many computers or on a narrow course limited to one;

(g) keeping pace with new developments and deciding which are likely to remain valuable for some years;
(h) choosing between a real machine or an imaginary one."

Mr. Clarke suggested two possibilities for the future:

(a) A system of National Courses, each college running a course tied to its own computer and accepted by a sponsoring Committee (similar to the Hives Committee), or
(b) a more fundamental course with a common National Examination, in which any part which cannot be the same for all students is treated as course work and submitted to the examiners prior to the examination.

The British Computer Society should assist in framing a general policy of education, possibly by providing members of advisory committees.

"Whatever system is adopted I feel that the function of a College of Advanced Technology should be:

(a) to continue the general education of a student,
(b) to give background and coherence to what he is learning, and will learn, in industry, and
(c) to ensure that the fundamental principles of technology are adequately taught."

* * *

PROBLEMS OF TRAINING SCHOOL LEAVERS

Emphasising that 1,000 scientists generate a lot of computing, Mrs. M. M. Barritt (*Royal Aircraft Establishment*) described how the problem of training a regular supply of programmers at RAE had been tackled. In 1955 some 400 staff computing on desk machines had to be re-trained for a wide variety of electronic computers, and the supply of programmers maintained to take care of normal wastage. A little over half the recruits are at ordinary GCE level and only 30 to 40% at "A" level. In 1956 RAE introduced optional computation in to the AEB GCE "A" level pure mathematics course. In addition special "rescue" classes, one day a week, were offered to staff of all ages aimed at gaining pure mathematics with computation at "A" level in one or two years, dependent on past academic training. In these courses the syllabus was augmented by elementary matrix algebra, binary arithmetic and programming. The importance of the "A" level computation syllabus lies in initiating the student into iterative methods, numerical differentiation and integration, and the study of rounding errors in elementary arithmetic operations.

"In the years 1957, 1958 and 1960, 30 to 40 students have successfully completed this course. All are capable of *ad hoc* operating and over half are satisfactory programmers within the limits of their knowledge of mathematical and numerical methods. Our experience has been that much of this promising material would have been lost had we insisted on equal prowess at 'A' level physics and/or applied mathematics. It may be that computing is more an art than a science, that the student who likes physics is not attracted to computers or vice versa, or in some cases the cause lies in the tendency to take the combined subject physics and chemistry at 'O' level."

The recruits at "A" level now go to the courses arranged by Northampton College, while the "O" level go to the "A" level courses first. Generally girls at "O" level are bad in physics and applied mathematics, while the boys are good. English is generally bad, although this is essential for program writing. Personality is important, especially with youngsters who might be expected to do open shop work. Throughout the programming training it is insisted that the student gets a program working as a test of patience and perseverance. There was as yet no training in commercial applications.

"Evening 'A' level courses in programming and computation have been offered at Farnborough, and this year a special course has been offered to school teachers and college lecturers. London University have started a new diploma in mathematics with an attractive choice of subjects; it is hoped that some students will be able to carry on to this level. With this in mind and the increased use of computers as tools on the various courses, we feel the school leavers should have a genuine chance of making good in this field."

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DISCUSSION

In the discussion which followed the main speakers there were clearly two points of view; those who were interested in training "pure" programmers and others (more interested in commercial applications of data processing) who urged the need for systems analysis and programming to go hand in hand. Some of those supporting the second school of thought went further to suggest that the commercial application should be looked after by systems analysts, recruited from existing staff, while coders can be recruited from school leavers and trained on the lines suggested by the speakers. While there was considerable support for this view, it was urged by some that systems analysts do not necessarily have to come from within the firm in order to analyse a system, provided they are well trained; they must know programming. If they come from existing staff they cannot see outside the present system. The internally recruited systems analyst without basic mathematical training is a "sacred cow" which needs shooting. Many speakers warmly defended the "sacred cows"; programmers are apt to become too specialised and have little appreciation of clerical matters. There was general agreement, however, that technical training to some degree *is* essential.

The importance of a programmer having the right personality, being able to write English, and having a good liberal background education was stressed. These cannot be provided by courses, especially to people with limited release from work. There is a need to fill the gap between secondary, technical and grammar schools and the universities. Attempts have been made to run courses for school teachers in programming so as to stimulate their interest in this as a career for their pupils. Teachers in grammar and secondary modern schools are not interested.

It was commented that computers are not reflected ade-

quately in courses offered by professional organisations in the commercial field. Their impact on management techniques is not stressed; against this it was suggested that management by exception is still a pious hope and managements cannot be persuaded to accept it. Those who have been unsuccessful in persuasion become consultants! There are misunderstandings caused by failure to communicate, which springs from lack of education of senior executives. Reference was made to the special BTC courses at Manchester, the general reaction being that these were immensely successful and stimulating. Rescue classes had been held at RAE for people as old as 40 who had to learn new techniques; with carefully chosen teachers and patience, they had only two failures out of 20 who went in for the AEB examination. There was a general need for 2 to 3 week rescue courses of this nature for people in business before they go on to manufacturers' programming courses. Combined with appreciation courses, this sort of training goes a long way towards teaching systems analysis and programming in the commercial data processing field.

It was also stressed that such training should wherever possible be on an actual and not a theoretical machine; actual experience is vital, whatever machine may be available.

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PROBLEMS OF RECRUITMENT

On the last day the Conference discussed problems of the internal and external recruitment of computer staff. The meaning and scope of "computer staff" in this context was defined by Mr. P. G. Barnes (*De Havilland Aircraft Co. Ltd.*) as all those with a "detailed" interest in computers (such as systems analysts, programmers and operators) as distinct from the wide interest of general management.

In his own company, Mr. Barnes said, systems analysts are deployed in departments of the company, responsible to the Departmental Manager. "It is their job to interpret his requirements for computer work. With the help of O & M and Data Processing Departments the systems analyst must translate his management's requirements into a computer program. Systems analysts produce flow charts, design documents, organise any change of manual work in the department and generally see that the computer programmer is giving him what he wants." They must therefore have qualifications acceptable to the departmental manager. In practice this means for scientific work they have a degree, but for commercial work professional qualifications or long experience of the job.

"On to the knowledge of the department and its requirements we must build a general knowledge of computers and O & M work. This knowledge can be fairly general since he will have the services of full time O & M computer programmers. Getting a job on to a computer is a team effort; no one man does the lot."

Computer programmers (responsible to the general computer service) take a directive from a systems analyst and organise, with him, the detailed planning of the job. The programmer then writes the program and sees it satisfactorily handed over for production running. "They are the 'maids of all work' in our system. They must understand basic procedure for system study and O & M. They must also be able to program the computer. Recruits who have programmed a computer are more useful than those who have not. It does not matter which computer has been used as long as the student has written a complete program for a computer *and* written it up. It is important that would-be programmers are taught the art of report writing, and, as has been said, of writing English. Is it too much to ask for a standard method of program write-up or, for that matter, a standard write-up form for a job specification?

"At De Havillands we think of programmers as degree standard. To this must be added training on system study, O & M computer programming and report writing. For commercial programming a degree is useful but not a necessity. A logical outlook and right personality will suffice."

Operators are the staff responsible for production running on the computer. Ancillary equipment operators of punched card and tape equipment can be trained by manufacturers, but very frequently are trained internally. Computer operators are usually trained internally. These staff are GCE level. Entry at this point could, with suitable evening or day release classes, start a useful method of training computer programmers.

There are three basic methods of recruiting computer staff:

(*a*) From universities, technical colleges and schools. "We hope that recognised qualifications will be established so that selection can be made on formal qualifications and personality for the job, such as an honours mathematician who has done practice calculation on a computer instead of practical physics in his second year, or an accountant who has included computer appreciation in his examination. I do not believe in aptitude tests for honours degree students and prefer to judge them on class of degree and personality. However, for ordinary degree students an aptitude test can help."

(*b*) By advertising. At the moment this is generally found not to be very successful, and may be due to badly framed advertisements (because of lack of national effort to define the job), non-existence of the type of staff required (because of lack of suitable training facilities) or inadequate inducements to join the company.

(*c*) By internal recruiting. "This is particularly useful for systems analysts and computer operators. A systems analyst can be selected from his background and knowledge of the Department's work. Usually a young deputy head of a section is a good person to train. Personality plays a big part in selection. Computer operators can come from anywhere. We usually ask for GCE 'O' level in Maths, but if we like their faces we can train them. In both cases the younger the person the better—say between 25 and 35 for systems analysts, younger for operators."

Computer programmers are more difficult to recruit internally, but it is a hard fact that this may be the only source. "It is also not a bad thing for company morale that existing staff are given a chance to enter data processing—to become 'contented cows.' "

Mr. Barnes went on to describe the type of aptitude test used by his company for internal recruitment. Lasting a day, it combined lectures, a test of 30 questions (including some on the lecture and an essay) and two interviews. This has proved successful, the results of tests and interviews being well correlated, unaffected by the varying backgrounds of individuals.

The need and value of some examination standards in recruiting and selecting computer staff were discussed by Dr. J. Corner (*AWRE, Aldermaston*). He drew a distinction between recruitment and selection, saying that the former problem can be solved by offering higher salaries to already experienced people. He was concerned with selection of people not already working in the field, of three types: operators, coders and numerical analysts. He was also dealing with the needs of scientific computing only.

Potential operators come in from school after the GCE, and no professional qualifications can be expected. They must have an interest in mathematics (GCE advanced level) and must be generally alert. Smart young women, good at getting on with people, are good material. They are given tests on primary arithmetic. These methods have shown no failures yet. He did not see that one can set up a professional qualification for slickness of operation, nor is there any need for one.

Coders or programmers take about one month to learn to use any particular machine order code, so that there is no point in trying to select people because they have already worked on one particular type of machine. But some program experience is important. The main bottleneck in coding is "debugging". The ability to debug quickly is the greatest virtue in a programmer. This can be recognised by mathematical ability (class of degree) and such things as an interest in puzzles. A potential programmer must not be bumptious; this is particularly embarrassing if the machine reliability is low. It is helpful to get him talking about the competence of engineers. Experience improves a person's ability to debug their own programs; they know their own types of mistake. Mathematical training helps in debugging and Dr. Corner would like to see some proof by way of a professional qualification that he can debug swiftly. This simply amounts to a proof of mathematical ability, geometry in particular.

Numerical analysts lay down the strategy for the programming. All evidence is that this can be taught, that it needs good mathematical ability, and that since people usually do not realise there is anything to learn until they have been taught, they must have deliberately studied numerical analysis. A professional qualification, he considered, is necessary here.

The computing field is expanding rapidly, so that there is much transferring. Also, female operators marry early, so that misfits are rarely around for a long time. A large organisation is always better if its individuals have special abilities in different lines; for a small organisation, however, none can be permitted to be seriously deficient. In the large organisation it is easier to move misfits without stigma.

Coders vary much more than operators in their effectiveness. This occurs at the debugging stage. "If one is dealing with big programs, there is everything to be said for getting the best possible coders. Therefore one must investigate thoroughly during selection. A professional qualification, if feasible at all, should not just separate white sheep and black sheep; it should grade them into several lots.

"Numerical analysts have the power to waste computer time, and to get away with their crime. Worse still, they can choose a computing scheme which, after coding and after debugging, proceeds to give endless trouble and doubts, and finally has to be scrapped. Hence a professional qualification (and I think this *is* feasible) should preferably be a grading into several classes."

DISCUSSION

Opening the discussion on the Conference, Mr. A Geary (*Northampton College of Advanced Technology, and Chairman of the British Computer Society's Education Committee*) said that the Conference had pin-pointed many of the difficulties and problems facing the Society's Education Committee. There had been many differing points of view put forward; he instanced the differences expressed by various speakers on the qualifications of maintenance engineers, and he himself challenged Mr. Hinds' suggestion that engineers should generally only be of ordinary national certificate level. More intelligence is needed than is found in low level candidates (he had assessed 1,500 lately).

On methods of selection, he felt that interviews are not very reliable. He suggested that tests are needed also for interviewers as well as interviewees, as otherwise there is no common standard. Aptitude tests are a better means of measuring intelligence. The precise type of test does not matter; the important point is to test an individual's ability to deal with an unusual situation. As a note of warning, he stressed that an aptitude test still does not show how people will develop, but only their standard at this particular stage.

He endorsed the feeling that the ability to write good English is important; unfortunately, many tests do not show this.

More graduates are now finding places in industry, but this only applies to men. There is need for more co-operation between industry and education.

* * *

In the following general discussion it was stated that, with reference to Mr. Corner's remarks about selecting coders, those with pass degrees make little headway with debugging; on the other hand, those with no degree at all often do. It is very difficult to know how to examine a person in debugging. For a numerical analyst it is most necessary to test his power to communicate with other people in varying situations. The view of a commercial user was that the computer is only a means to an end; there must be no loss of status to computer staff and they must therefore have management potential so that over-specialisation is unwise. This was countered by the suggestion that the right way for management or executives to understand the computing business is to pass through the computer department themselves.

The opinion was expressed, and found general agreement, that we are still a long way from the position of being able to have professional status for computer staff by examination. For a strictly professional examination it is necessary first to define the precise jobs, and it was clear from the many views expressed at the Conference that we could not yet agree on what we are examining or even what the functions are of different types of jobs. A possible alternative is the broader one of including programming in a degree course. Another speaker suggested that the need is for a series of examinations

of varying standards. A serious difficulty, however, is that one cannot test practical ability to produce results without a practical examination.

* * *

INTEREST OF OTHER PROFESSIONAL BODIES

It was questioned to what extent accounting and other professional bodies have studied the impact of computers on accounting and on its teaching. While no professional bodies were officially represented, several members expressed personal views. One accountant suggested that while those of his profession employed in industry are generally looking ahead to some fairly radical changes in accounting methods and management control techniques, the practising accountants and auditors have not yet realised what is likely to hit them. Little organised education of the profession is being attempted, apart from a very small amount of computer appreciation given to students as a part of machine accounting. He urged that the Society have a useful task to perform in approaching the professional accounting bodies to discuss such matters with them. This would be a practical way of seeking the close co-operation with other bodies stressed by earlier speakers.

In the office management field, a speaker suggested, there is more awareness of the impact of computers. He pleaded that the training of systems analysts for commercial applications should not be overlooked; a wide background is needed for this with a managerial approach and cost consciousness. Another speaker stressed, however, that the role of the computer in the commercial world should not be overstressed. Many changes such as had been mentioned could have occurred without computers but the introduction of computing techniques does enable a large organisation to be as efficient as the small. New people in the accounting world as a result of introducing computers will lead to new thinking. In general there are too few prospects at present to attract the right sort of computer staff. While an analytical mind is needed, another qualification as well is essential.

A further view put forward was that as every business has its own staffing needs and its own methods of selection and training, we should fall back on the manufacturers' courses for specialist training on particular machines. It might be impossible to establish general examinations and there is some suspicion as to the effectiveness of personality and aptitude tests. Another speaker said that no emphasis had been laid on autocodes during the Conference. There was urgent need for a common notation, and this leads to autocoding and to general schemes for this. Perhaps computer staff needed to be trained only in autocodes. Against this it was stressed that, with the large number of personnel needed in the next 5–7 years, there would be great advantages in examinations at an elementary level to give an introduction to computers. This would give school-leavers an opportunity to discover if they are interested in the subject, and make valuable raw material available for rapid on-training.

* * *

SUMMING-UP THE CONFERENCE

Reviewing the one and a half days of the Conference, Mr. E. C. Clear Hill said that the Education Committee now had much material which they would need to consider very carefully. He was impressed with the wide scope of the discussion and reminded the Conference of the initial questions which Dr. Buckingham had posed at the opening of the symposium.

Firstly, could aptitude tests play a useful part in the selection of personnel? He felt that general opinion considered that they could, although more work on them is needed. Some speakers had given clear evidence of their value. He was not unduly disturbed by the suggestion that a genius might possibly be missed by such tests; by definition, a genius would probably not obey the rules anyway. Creative ability would never be measured by any test.

Secondly, would selection of computer personnel be assisted by examination courses, leading to some preliminary qualifications? The experience expressed by many speakers seemed to show clearly that this would be so.

Thirdly, could useful courses be devised which are not directed to a particular computer? Many speakers had emphasised the value of general courses, but it was also clear that practical training on a machine is necessary if the course is to have real value.

Fourthly, are different types of courses necessary for commercial and scientific users? He felt that the differing views expressed by these two interests at the symposium made this clearly essential.

Lastly, could courses on computers be introduced into the curricula of technical schools? The many examples given of such courses show clearly that this is possible and should be encouraged.

The introduction of the computer has given management a tool, capable of making a tremendous impact. The education of executives is another pressing need. This has to be added to the need for about 20,000 new personnel intimately connected with the computer in the next few years, referred to by Dr. Buckingham. There is an essential and immediate task to make a serious enquiry as to what the precise numbers are likely to be and to get an accurate picture of needs. We must be certain whether the target is the right one and whether our sights and aim are right; whether we have the right approach. It is also necessary to distinguish between the needs of the computer industry and the needs of the users. He was surprised that there had been no reference to the possible development of data transmission, with resulting centralisation of computing staffs; this might have an effect on the total numbers required. Other bodies such as DSIR and BCAC are concerned, and there will have to be close association of these and similar interested bodies.

The Conference had clearly been impressed, as he had been, with the statement by Mr. Heitz that professional status in the United States is already established, defined as "widespread recognition through achievement". Mr. Heitz had also stressed that there is no substitute for experience. This has more than a little bearing on the references to "sacred cows" by other speakers. The existing ideas in business are not all wrong, and this experience must clearly be retained. To mix metaphors and menageries, no bulldozer is going to shift the sacred cows.

Until near the end of the Conference there had been no reference to a career structure; this leads to stability in staff, and can extend sideways as well as up. This is an important aid to recruitment.

Listening to the many qualities demanded by various speakers of computer staff, no advertisement could cover all

these, which run literally from A to Z. Many of these, however, are general qualities required by any successful man. He suggested that the formation of character during training is essential, especially in relationships with other people. He considered the three most important qualities for computer personnel to be complete technical integrity, honesty, and, perhaps most important, modesty.

In conclusion, Mr. Clear Hill expressed the thanks of the Society to those who had prepared papers, to the other speakers from the body of the Conference, to Mr. D. H. Rees (Honorary Meetings Secretary) for organising the symposium, and to the Northampton College of Advanced Technology for allowing the Society to use its Great Hall and for making all the housekeeping arrangements.

COMPUTERS HAVE NO SEX LIFE!

We are indebted to Mr. J. W. Mitchell for communicating this thoughtful, stimulating paper, an outcome of the psychiatric approach to logical thought so fruitful in the design of equipment. The conclusions reached by the single-minded people who have been pursuing the subject are bound to have important repercussions in the computer industry.

Computers have no sex life. This is a perfectly honest statement of fact, a fact which has unfortunately been overlooked by the majority of experts when trying to explain away the misnomer "Electronic Brain," which was once applied to computers. It is now well known that they are not active brains in the true sense of the word; however, the doubtful argument that they cannot think, but are only capable of the accurate and rapid reproduction of logical thought processes, in a predetermined variable pattern, is now falling rapidly by the wayside.

Basically computers have to be instructed, and they will obey their instructions right or wrong *ad nauseam*. They are capable of performing arithmetic and certain logical fuctions, making simple decisions, etc. They have memories and are widely acknowledged to be capable of receiving and transmitting information. All of which, as many will realise, is far beyond the capabilities of many human beings, who invariably make mistakes in arithmetic, act illogically, dither instead of being decisive, forget things rapidly, and often prove themselves incapable of either receiving or transmitting information correctly. Most of these human functions can it is believed be reproduced in a computer by a reasonably incompetent engineer.

Some of the latest developments in the field of computing equipment are proving themselves and it is now said that the latest machines can in some instances "learn by experience" and modify their actions accordingly; a very human trait. Some machines have even generated instruction routines of a few steps for their own use; this has however proved a time-consuming process and is unlikely to replace the use of Assembly and Compiler programmes for a short while yet. Should self-generation develop to any great extent however, we shall still be safe from machine domination so long as we hold the On/Off switch.

Computers are gradually entering many walks of life, Automatic Offices are an accomplished fact. Machine-Tool Control, and Automatic Factory-Throughput Control are with us. First generation computers have been used by engineers to carry out a considerable amount of the design calculations when preparing plans for second generation equipment. Judging from developments, we shall shortly have computers controlling automatic factories for the production of computers, for the control of automatic factories for . . . ? Hardly sexual reproduction, *but* . . . How the human race will develop from that point has yet to be seen. In the meantime it surely behoves us to prepare for life in the Electronic Age, which we hope is here to stay.

Notwithstanding all the fascinating developments which have taken place in the electronic field, as yet the scientific genii responsible for the design of these machines have been unable to arouse any emotional feelings in the hardware. There is of course often a strong emotional feeling aroused in the engineers and operators who work with these machines: varying from pure frustration through despair to violent hatred according to the temperament of the machine involved and the person concerned. Computers have very definite and distinct personalities, but as yet *no* sex life. One dreadful thought torments me, however: perhaps some reader may commence research into this last position where animal and vegetable life still reigns supreme. When and if this does occur all will indeed be lost.

IBM Opens a London Data Centre

One of the most powerful computing centres in Europe is being opened during June by *IBM United Kingdom Ltd.* at 58 Newman Street, London, W.1. Known as the IBM Data Centre, it will be equipped with IBM 7090 and 1401 Data Processing systems, as well as supporting equipment.

At the Data Centre IBM will maintain this equipment for the use of commercial and scientific organisations which wish to write their own computer programs and operate the machines themselves. This differs from the service offered at the IBM company's Service Bureaux, where programming and operating staff are provided by IBM, but is similar to the service already offered by certain other British manufacturers in London.

Although, at the Data Centre, the customer accepts full responsibility for operations, IBM will provide maintenance staff and also specialists who, without any additional charge, will be available to advise customer programmers and operators on the most effective use of the equipment. They will also give programming courses.

This method of operation at a Data Processing Centre has three advantages. It cuts the cost of using the equipment to the minimum; the customer keeps full control of the job;

and the experience gained is valuable if that organisation later decides to install its own equipment.

Users of the IBM Service Bureaux will also have access to a computer of the capacity of the 7090 for the first time, since the Service Bureaux can also draw on Data Centre facilities. Clients of the Data Centre have access to the SHARE library of IBM computer users, one of the largest collections of computer programs in existence in the world. It is expected that the centre will be used, not only by large commercial companies and organisations engaged on large scale research, but also by a wide range of medium and smaller organisations that have no such computer facilities for their work.

The IBM 7090 fully-transistorised system is claimed to be the most powerful computer in general computer use in the world. At present there are two others in Europe one of which is with the UKAEA, and the other was installed in Paris in the Spring.

The 1401 can be used either as off-line equipment for the 7090, or as separate computer system itself. It is a small-size computer, with a very high card reading and punching speed and a printing speed of up to 600 lines a minute. The 1401 has achieved a remarkable sales record since it was announced: over 90 have been sold in Britain and well over 3,000 throughout the world.

DISCUSSION GROUP NEWS

The following groups are active this season:

1. Input and Output
2. General Accounting
3. Feasibility Studies
4. Operational Experience
5. Advanced Programming
6. Production Control, Scheduling and Stores Control

15. Statistics
17. Numerical Analysis

Any member of the Society who wishes to take an active part in the work of any of these groups should write to P. V. Ellis, I.C.T. Computer Group, Putney Bridge House, London, S.W.6.

It may be appropriate to mention in good time before the next Winter Session that the main inspiration for new activities and for support to existing activities can only come from members of the Society. It is not too much to ask that every member of the Society gives a little thought, even if only once a year, to how his/her Society can be improved and then writes some positive thoughts to an official of the Society. The Chairmen of the Business Group and the Scientific and Engineering Group Committees will welcome help in this direction at any time.

Some further details regarding the activities of representative groups will help members to appreciate the scope of their investigations. The Chairmen and Secretaries of all the groups are to be congratulated and thanked for the considerable altruistic work they carry out to help their fellow B.C.S. members.

Group No. 5—Advanced Programming

Now that the COBOL sub-group has completed its reports and disbanded, two further sub-groups have been formed which will meet fortnightly for study and discussion in the following subjects:

1. The study of users requirements as regards commercial autocodes
2. The theory of compilers with particular reference to the design of a compiler for COBOL.

In addition to its serious activities the group meets in a relaxed atmosphere once in a while to wine, dine and discuss anything but advanced programming techniques.

Group No. 6—Production and Stock Control

The group recommenced activities in January to work through a set programme of topics at meetings held once a fortnight. Subjects include methods of forecasting demand, especially exponential smoothing, ordering policies, control of deliveries, machine loading, progress control, analysis of orders to determine requirements of individual components and starting dates. The discussions are sufficiently interesting for one member at least to travel a hundred and fifty miles to be present at the meetings.

Group No. 17—Numerical Analysis

This new group, formed in September last by its present Chairman, Mr. H. Goldenberg of the Electrical Research Association Laboratory, has got away to a splendid start. About a dozen members on average have attended meetings held in London to hear the following papers read:

1. Dr. G. N. Lance—Some thoughts on automatic step changing techniques in the solution of ordinary differential equations.
2. Mr. C. W. Cryer—Work in progress in the Cambridge Mathematical Laboratory.
3. Dr. H. H. Rosenbrock—An automatic method for finding the greatest or least value of a function.

Future arrangements include subjects such as error analysis of eigenvalues and eigenfunctions, and Chebyshev Polynominal approximation.

P. V. Ellis

REGIONAL BRANCH NEWS

BRISTOL

The Branch's activities during the past months have comprised a series of five lectures, and the Conference referred to elsewhere.

The lectures have dealt with a wide variety of topics, including "Computers for Beginners," "Machine Tool Control," "Learning Programmes," "Computer Experience with a Local Authority," and the "Cobol system of automatic coding."

Membership of the Branch has increased several times since the Branch was formed less than eighteen months ago. Attendance at lectures has averaged 33.

LEICESTER

The Branch has concluded its session with three very successful meetings. On 19 January Dr. S. Gill of *Ferranti Ltd.*, described the ATLAS computer. Mr. A. R. P. Fairlie of *Remington Rand Ltd.* spoke about the use of computers in the boot and show trade. This took place on 16 February. The final meeting was on 16 March when Messrs. P. R. Wykes and G. C. Rowley of *A. V. Roe Ltd.* spoke on the design and application of digital differential analysers.

MIDDLESBROUGH

The branch can look back on a successful third season. Eight meetings have been held with attendances of between twenty and thirty, including visitors.

The season opened with a visit to the ICI Wilton computing centre which is equipped with a Ferranti MERCURY. Mr. P. J. Lown (*Reckitt's Ltd., Hull*) addressed the branch on "Order-handling-invoicing and maintenance of customers' accounts"; Dr. Tocher (*United Steel*) on "Simulation"; Mr. F. F. Land (*Leo Computers*) on "Stock Control on a Computer"; Mr. W. S. Ryan (*GPO*) on "Data Transmission"; Dr. R. Sargent (*Imperial College*) on "Computers in Chemical Engineering Design Offices"; J. A. Goldsmith (*Robson and Morrow*) on "Achievements in Electronic Data Processing in the United States."

We are grateful to these speakers for giving their time and, in most cases, travelling long distances to be with us.

There are four computers on Tees-side at present. Shortly there will be at least two more, so that the Branch, already firmly established, should expand and flourish.

SOUTHAMPTON

An audience of sixty local members and friends was present at the inaugural meeting of the Branch held on the 10 April. They had come from as far afield as Bournemouth and Aldermaston. The size and enthusiasm of the audience more than confirmed the original organiser's opinion that a local branch was needed.

After a short business meeting at which Dr. P. A. Samet was elected Branch Chairman for the year, Mr. D. W. Hooper, Vice-President of the Society, gave a very stimulating address on the use of computers in Management.

A lively exchange of comments followed and many were sorry when the clock brought the proceedings to a close.

Dr. Samet thanked the Speaker for launching the Branch with such enthusiasm.

A second meeting to elect a committee and hear Dr. Samet talk about "The Training of Programmers" was held on the 15 May.

BOOK REVIEWS

Management Organisation and the Computer

Edited by G. P. Shultz and T. L. Whisler, 1960; 257 pages. (Illinois: *The Free Press of Glencoe*, $7.50.)

The impact of computers on British management has still to be felt. Users of this new tool are still preoccupied with the technical problems of installation. They tend to be looking for quick cash savings to justify purchase and longer term benefits from the integration of clerical procedures.

In *Management Organisation and the Computer* a small group of American academics and businessmen have performed a valuable service. They discuss frankly the *organisation* problems which have to be solved before full value can be obtained from a computer. Of the users represented at the seminar, which formed the foundation for the book, one was from a business with about 1,600 employees; four represented very large industrial enterprises operating on a national and an international scale.

The small company appeared to have fewest organisation problems and it seems possible to make the general comment that largeness brings its own problems which, in organisation terms, the computer complicates. These, if the contributors' views are typical, arise in their most worrying form, in the personnel sector.

Some emphasis was placed in the discussions on the position of the computer department in the business. Linked with this question is that of the future relationship between "line" and "staff" departments. There is a clear tendency on the part of the users to see the computer department moving from a staff to a line position in the structure, becoming, in effect, the main planning department in the enterprise. They seem, however, to envisage a radically different staffing from that which is typical in Britain.

Looking at the enterprise as a whole they foresee a greater degree of centralised decision-making, particularly where data can be quantified. Decentralised decision-making will remain where the "local feel" is important. While in terms of

financial efficiency this may be the correct organisation decision, the problem of down-grading erstwhile decision-makers becomes more acute and the disadvantages of reducing the apparent status of middle managers may outweigh the surface advantages of centralised decision-making. The same criticism may be made of their view that top managers will tend to make more detailed decisions when they have more complete information available.

They also touched on the question of management training, but expressed contradictory views. Some held that managers need to be aware of how a computer works while others suggested that, in time, we shall regard a computer as we do a motor-car. Many of us drive without knowing anything about the engine. It is permissible to wonder how many managers are concerned that they know nothing of the working of a punched-card installation. The novelty of computers will, without doubt, wear off.

The book is arranged in four parts. Part I is, in effect, an annotated summary by the editors. Part II deals with the computer as a technological development. In Part III certain concepts of organisation theory as related to computers are raised. Part IV presents the experience of five computer users. Each part concludes with excerpts from the discussion following the papers. The book is well indexed and contains a selected bibliography.

Current and potential computer department managers who are interested in the position of their department within the organisation structure of their company will read the book with profit.

J. H. Leveson

EDP Idea Finder

1960; 656 pages. (Los Angeles: *Canning, Sisson and Associates Inc.*, $26.)

This large and unusual book is a vast storehouse of information on data-processing systems. For the past six years, the *Data Processing Digest* has selected the most important articles and papers from the leading periodicals, magazines and professional journals. Most of this information, which covers computer processing of commercial and industrial data, has been collected in the United States and this country.

The *EDP Idea Finder* has effectively selected, grouped and classified the most interesting of the digests which have been published during the past three years. The value of this information is not immediately apparent but careful study reveals a wealth of ideas most of which are based on practical experience. The amount of detailed information given varies considerably. No aspect of EDP has been neglected, although the information on some of the newer processes is sparse.

Data Transmission has received some attention and the important digests on the special aspect of error detection and correction have been included.

The section dealing with Character Recognition provides a valuable précis of the work done to date and gives considerable prominence to the studies in progress in this country.

Operational Research studies are both numerous and frank, and provide considerable detail on the various applications, limitations and scope.

The digests on Production Control and Inventory Control are very mixed both in length and detail. This subject is usually illustrated by charts, and the lack of those with the digests tends to detract from the value of the information provided.

The last two parts give comprehensive references to a wide range of publications, bibliographies, periodicals etc., dealing with all aspects of EDP and associated management problems.

The claim that the "Idea Finder" will become "an essential desk companion to those engaged in data-processing work" is, in my opinion, fully justified.

L. R. Crawley

Magnetic Tape Instrumentation

By G. L. Davies, 1961; 253 pages. (London: *McGraw-Hill Publishing Company Ltd.*, 66s. 0d.)

The fact that this review is published in the papers of the British Computer Society should not lead the reader to suppose that the problems of designing and engineering computer magnetic tape systems are adequately dealt with in this volume. Magnetic Tape Instrumentation is the title of the book, and to the worker in this field the book is a delight—perhaps the only expert book available in a relatively new and rapidly diversifying branch of engineering. But digital techniques are only satisfactorily dealt with in their application to the acquisition and recording of prime data. In this respect a comparative study of the characteristics of direct recordings, FM carrier recording, pulse duration modulation and digital recording is well presented.

While the design parameters which are common to both linear and digital recording system are very adequately described, the author glosses over the prime factor of digital recording—the accumulation of the variation factors in amplitude, noise and phase, and the assessment of the pulse density which may satisfactorily be used under a given set of parameters. While the author admits that equipment used in the prime acquisition of data is less demanding in this respect than equipment used in data processing, this assessment is still a major problem, and sets the performance limit of the system.

Perhaps one of the major contributions in this book is the section dealing with the handling and storage conditions of tape and the design of spools. It is only too seldom realised by operators that inadequate attention to these factors limits the performance of a system just as much as the initial quality of the tape or the precision of the heads and guides. Digital system designers could well give this section their very close attention.

The treatment of the phase characteristics of the recording process is given the prominence it deserves. Your reviewer however could find no mention of the secondary gap effect, nor of the effect on pulse phase of the initial condition of magnetisation of the tape—nor indeed of a description of dual write/read head-stacks—a grave omission in a book which claims to deal with digital recording. The logical design of digital systems is not covered, and is perhaps fairly outside the scope of this book.

Finally this book has the failing of many contemporary American technical volumes—apart from one or two exceptions, all the references are from American publications. In the computer context one would particularly have liked to have seen mention of the development of magnetic drum systems at Manchester University, and the novel Swedish Carousel machine.

D. W. Willis

Programming for Digital Computers

By J. F. Davison, 1961; 174 pages. (London: *Business Publications Ltd.*, 35s. 0d.)

This book, states the author, concentrates entirely on the programming aspects of computers. It is intended to be completely intelligible to the non-mathematician. His prose is certainly very lucid although occasionally he demands a standard of numeracy beyond that of the layman. His basic machine is TRIDEC, a small imaginary computer, and thus he reinforces the ranks of the authors who, for general educational purposes, prefer such imaginary computers to existing installations. The reviewer himself sympathises with this viewpoint. The book can be recommended as a very useful contribution to the introductory literature on computers. The sub-title "Putting computers to profitable use" is a little puzzling but the reader who gives this book the attention it deserves will no doubt proceed to justify the phrase.

M. B.

Field Computations in Engineering and Physics

By A. Thom and C. J. Apelt, 1961; 165 pages. (London: *D. Van Nostrand Company Ltd.*, 30s. 0d.)

This book is devoted to the description and application of what the authors term the method of squares in field calculations. A "field" is defined as a two dimensional region. The term "squares" derives from the manner in which the finite difference equations are solved. The field is covered by a regular mesh and the value of the required function at the centre of a square is computed using values at mesh points lying within the square. The side of the square may be several mesh intervals in length so that high order difference formulae may be employed. The method has much in common with the Liebmann method for solving elliptic differential equations and suffers from the same disadvantages.

The early chapters in the book describe the method of squares by application to Laplace's equation and discuss the manner in which boundary conditions may be applied. Later chapters discuss the application of the method to Poisson's equation and a number of problems in fluid dynamics. Fourth order equations are briefly discussed and there is one chapter devoted to convergence and error propagation.

The book is well written and will be easily understood by students with no previous experience of numerical analysis. It will clearly be of value to postgraduate students in the fields of engineering, fluid dynamics and applied mathematics who have problems requiring numerical solution but no deep interest in numerical analysis for its own sake. The method has been developed primarily for use with desk calculators but it is easier to code for an electronic computer than Southwell's "relaxation" method because of the systematic way of working through the mesh. However, this does not make the method of squares the best available for computer application.

The authors do not seem to have considered a field consisting of more than about 400 mesh points. In many practical problems in the field of reactor physics, for example, ten thousand mesh points is not unusual and fifty thousand are contemplated. Then, even on the fastest computer available, the method of squares would be prohibitively slow, and it often proves difficult to code for automatic application by a computer the method of extrapolation which the authors suggest will help to speed convergence. Then explicit methods, such as the successive point over-relaxation of Young and Frankel, or implicit methods, such as successive line over-relaxation, prove to be considerably faster. There is no acknowledgment of this fact in the book which does not compare the relative speeds of convergence of the method of squares with other available methods.

The book is a good one on the topic chosen by the authors, but the method it describes has been superseded in many fields of computer application.

H. E. WRIGLEY

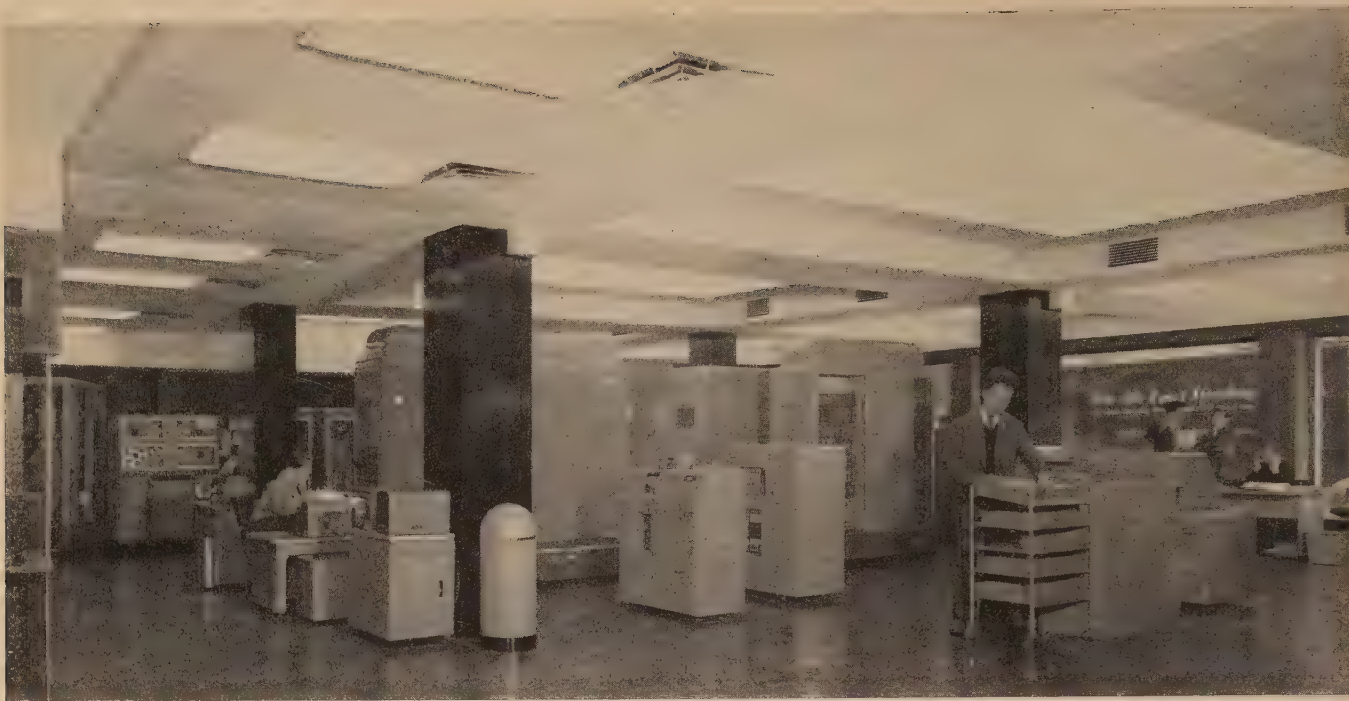
LONDON COMPUTER CENTRE OF FERRANTI LTD.

*by J. F. Nicholson**

The Ferranti Computing Service, which since 1955 has been based on a PEGASUS 1 at 21 Portland Place, has now been extended by the bringing into use of new computer installations at The London Computer Centre, 68–71 Newman Street, W.1. This centre is the new London headquarters of the Ferranti Computer Department, and, now that its computer installations are operational, it is fully equipped to deal with most problems of computing, both theoretical and practical.

The computer installations at the new Centre are on the ground floor, and at present consist of a PEGASUS 2 data processing system, including punched card input/output and five magnetic tape units, and a SIRIUS computer which, with 3,000 words of additional storage (making 4,000 words in all) is about equivalent in computing power to a PEGASUS 1. Later a full scale ORION data processing system will be installed. These computers, apart from acting as showroom exhibits of the Department, are available for use not only by prospective purchasers of Ferranti computers but by computing service customers also. This diversity of use continues the tradition established at Portland Place of having computing service staff and sales staff, each backed by programming effort, working closely together and both making use of the same computers. Such a closely integrated system is perhaps the best way of ensuring that a computer centre is truly a place where all aspects of a computer application can be thoroughly thrashed out. The London Computer Centre, in addition to housing sales, computing service and programming staff, also houses the London Maintenance Office

* Ferranti Ltd.



of the Computer Department, dealing with maintenance of customers' installations, so the visitor with almost any query on Ferranti computers will find at the Centre an expert who knows the answer.

Before going on to describe how the experience gained at Portland Place has been applied to the layout of The London Computer Centre, it is worth recalling that from Portland Place more than 60 medium and large computers have been sold and more than 20,000 hours of computer time made available. Those who have grown to like the eighteenth-century dignity of 21 Portland Place will be pleased to learn that it will continue to function as a fully staffed computer centre, with salesmen, programmers and the PEGASUS 1 computer.

The new Centre comprises a modern office block of 28,000 square feet floor area, built of reinforced concrete. A significant factor in choosing this particular building was that it is one of the few modern office blocks which were available in Central London which have a floor loading high enough (150 lbs. per sq. ft.) to allow the installation of computer equipment.

The whole of the ground floor is given over to the main reception area and the suite housing the computer installations. From the reception area a door leads directly to the computer suite. The computer room, which is fully air-conditioned, contains only the computers, their associated input and output equipments and the desks of the duty programmers and log-keepers, it being intended that the room should be occupied only by people actually using one of the computers. All other activities are catered for by other rooms—a control centre for reception of visitors and for computer bookings, an office reserved for the use of visitors, a tape editing room, and a card preparation room. These rooms are all temperature controlled and incorporate acoustic tiling to reduce noise.

To ensure that the day to day running of the work load on the computers is smooth, the computer-booking system and log-keeping system developed at Portland Place has been applied to the new installations and this results in an orderly flow of work by many different people each day—the schedule seldom running more than a few minutes out. The log-book entries are regularly processed by the computer to produce essential statistics.

Customers may operate the computers at the Centre themselves if they wish, and this is the method adopted by many users on the technical side. Commercial customers, with their greater problems of data handling on input and output, often turn their problems over to Ferranti staff to deal with entirely. Examples of this are sales analysis and market research analysis, jobs regularly handled by Ferranti staff for commercial customers. On the other hand, among the users who are customers for Ferranti computers and who are developing programs for them, it is the big data processing jobs such as banking that are handled by the customers' staffs, with the help of the Ferranti experts. The programming expertise, or "software," that is at the disposal of the computer users comprises expert advice on all matters of machine code programming, comprehensive libraries of subroutines for all purposes and the PEGASUS/SIRIUS scientific autocode.

On the first floor of the Centre are conference rooms and rooms set aside for the use of long-term visitors. These are essential features of a computer centre, for discussions with customers may go on over a very long period and customers' staff trying out programs on the computers at the Centre may be working full-time at the Centre for many weeks or months. Also on the first floor is a lecture room, holding forty-four, which is one of the chief means of linking the work of the fifty or so programmers at the Centre with the purchasers and users of Ferranti computers. Programming courses of one, two or three weeks are held regularly on ORION, PEGASUS, MERCURY and SIRIUS, and also on the ORION NEBULA (Natural Electronic Business Language). Among shorter courses, of one, two or three days, are appreciation courses on ORION and ATLAS, autocode demonstrations for engineers, and commercial data processing demonstrations for particular groups.

NEWS FROM MANUFACTURERS

BOAC System

A contract has been placed by the British Overseas Airways Corporation with *Standard Telephones and Cables Ltd., London,* for the supply and installation of an electronic system which will provide ticket selling offices throughout UK and Europe with up-to-the-minute information on the availability of airline seats on all flights operated by BOAC. The system will also give information on the flights of other airlines associated with BOAC; in each case the information will be available for flights over a period up to 20 weeks ahead.

Initially, a central magnetic-drum store of flight information in Airways Terminal, Buckingham Palace Road, London, will serve about 100 sales personnel using special keying sets within the Terminal Building itself. It is planned that this installation will be ready for service in the latter part of this year. Later, the system will be extended, using telegraph circuits, to various points in London including London Airport.

Further geographical extensions over standard telegraph channels will be made quickly to large centres in the United Kingdom such as Birmingham, Belfast, Manchester, Leeds, Glasgow and then to a number of cities in Europe.

The system affords great scope for additional geographical expansion and can be developed to perform other essential reservation functions. These extra facilities include the reporting of sales and cancellations over long distances automatically and at high speed. When this stage of development has been reached the numerical "inventory" of seats sold on each flight will be performed within the system. This development will necessitate changes only in the central equipment but not in the keying equipment being initially supplied.

The existing manual methods of promulgating seat availability information by the space control centre to all selling offices are expensive in terms of manpower and excessively slow in processing. By adopting the STC electronic system which operates at very high speed, BOAC is solving a fundamental problem and will ensure that its selling activity is of the highest order.

BOAC reservation clerk sets up an interrogation on her keyset

With the new system, the availability information is given automatically in a few seconds. In the initial phases booking will be carried out by telephone or teleprinter. The "status" information will be kept up-dated in the central magnetic store by control clerks. In the later phases, this up-dating and seat inventory will be accomplished automatically. Seats will be booked by a single push button.

The NCR 390 *system employs a dual-purpose ledger card*

Data Processing System Uses Magnetic Ledger Cards

Designed for general-purpose work in firms of all types and sizes, the NCR 390, and entirely new low-cost data processing system, produces everything from first records to final reports. It will enable thousands of businesses to enjoy many of the benefits of automation which hitherto have been restricted to users of large-scale data processing equipment.

The 390 sorts, summarises, compares, makes decisions, calculates, accumulates, up-dates balances, modifies its own programs, and controls peripheral equipment—all electronically. It employs a special magnetic ledger card, from which the machine reads information which would normally have to be entered through a keyboard. The complete system consists of a central processor, a console, and various input, output and memory units. The processor is transistorised and has a magnetic core memory for storing program instructions, accumulated totals and other data.

Every mechanical and electronic function of the equipment

is automatically controlled by the internally-stored program. This, however, can be varied at will by the monitor, who has random access to the memory units. Information is fed into the 390 in four ways—by direct entry on the console's keyboard, by punched paper tape, by punched cards, and by magnetically-encoded ledger cards. All of these input methods can be used simultaneously. Multi-form business records and accounting summaries are produced immediately in conventional print. Other output methods include punched paper tape, punched cards and magnetic encoding.

The magnetic ledger card provides an economical method of combining human language and machine language on one document, and thus opens up new opportunities for the low-cost automation of business work. Totals, balances, rates and other data are printed on the front of each account form and magnetically encoded on the back. In this way the 390 is equipped with a random-access memory of unlimited capacity. Whenever a magnetic ledger card is extracted from the file and placed in the carriage of the printer a complete record of the account is immediately passed to the processor. The encoding is done on a series of narrow magnetic strips superimposed on the back of the card. These can be likened to sections of the magnetic tape used in large computers. Up to 200 characters can be recorded on each card. The encoded information (which includes instructions for aligning the card in the right printing position) is automatically read and verified at high speed. When an account is processed, the 390 up-dates both the printed and magnetic information.

The magnetic ledger card not only supplies accounting information—it can also "interrogate" the central processor, and modify the program instructions to suit the requirements of the account to which the card refers.

As an input medium, the magnetic ledger has a wide range of applications. These include the creation of automatic trial balances, statistical analysis and management reports.

ICT at Hanover Fair

ICT were exhibiting at the Hanover Fair (30 April–9 May) through their German subsidiary ICT GmbH. Prominent features on the stand were ICT's 915 Tabulator and a model of the new 1301 Data Processing System. The 1301 Data Processing System was also the subject of an 8-minute film in full colour showing the actual machine with a commentary on its specifications and performance. The 1301 is fully transistorised with punched-card input/output 600 line a minute printer and magnetic tape.

Features of the new 80-column 915 Tabulator, which was demonstrating the production of invoices, are its capacity for complete adding, cross-adding, and direct subtraction, together with automatic selection, positioning and identifying of debit and credit balances. Its ferrite-core storage component enables information to be accepted from cards or counters, and emitted to counters or print unit, or to a card summary punch. The printing mechanism consists of 120 individually controlled alpha/numeric print wheels, capable of selective grouping, and the machine is equipped with 120 counters in 28 groups, with facilities for the introduction of sterling, weight, fractional or other wheels as may be required.

ICT were also exhibiting Punch, Sorter and Tabulator from the popular 40-column range of punched card equipment, particularly suitable for medium-sized undertakings.

Another EMIDEC Computer for the Army

A second EMIDEC 2400 data processing system, costing over half a million pounds, has been ordered from *EMI Electronics Ltd.* for the use of the Royal Army Ordnance Corps. It will be installed at the RAOC Depot at Donnington, to control stocks of technical stores. The first EMIDEC 2400 computer is scheduled for delivery in the summer of 1961 to the RAOC Depot at Chilwell, for controlling the Army's stocks of motor transport spares. When both computers become fully operational, 85% of the range of items of Army Ordnance stores will be recorded and controlled by EMIDEC systems.

Donnington's computer will control stock levels of 270,000 different items of technical stores, ranging from radar equipment to refrigeration plant, pistols to guided weapons. The EMIDEC will check that stores demands are reasonable for the type of Army unit making them and that the components requested are applicable to the main equipment mentioned. It will prepare issue documents and buying documents, and various statistics.

30,000 transactions take place at Donnington, on average, every week. EMIDEC will provide enormous processing ability for development of highly-sensitive stock control, which should result in lower stock levels being held.

Processing Data at Low Cost

The announcement that *The Builders Copper Tube Co. Ltd.* has ordered a Ferranti SIRIUS computer for commercial data processing underlines the fact that this type of work does not necessarily demand large and expensive electronic installations. SIRIUS is a small transistorised computer which can be installed by plugging into an ordinary electricity power point, and has been specially designed for ease of use.

The Builders Copper Tube Co. Ltd., a member of the Metropole Industries Group, is a distributing company which supplies a wide range of copper tubes and fittings to the building industry. The computer will be used at its head office in Tottenham Court Road, London W.1 for stock control, invoicing and sales and cost analysis. Some extra storage capacity will be added to the basic machine for this work.

The warehouse, containing some 5,000 different items of stock, is about a mile away from the head office. The two will be linked by teleprinters to enable the computer to be kept informed of the stock position, as sales take place at the warehouse, and also to enable the computer to send invoices and re-ordering instructions to the warehouse.

Invoice data will be produced on punched paper tape by the computer. The paper-tape information will then be sent by teleprinter to the warehouse, where it will be printed out on conventional invoice forms and advice notes. Printing-out will be done at the head office at the same time.

Re-ordering instructions will be produced by the computer by comparing the current stock level for each item with a pre-determined required stock level held on a punched paper tape. Any deficiencies noted in stocks will be transmitted by teleprinter to the warehouse and printed out there.

To help in dealing with particular enquiries, it will be possible to interrogate the computer to find the current stock level for any item. The required information will be displayed on numerical indicators when a button is pressed on a keyboard.

The SIRIUS computer occupies a floor space of only 25 square feet, weighs 13 cwt., and has a power consumption approximately the same as a domestic electric fire. There are two important reasons why the machine is easy to use. First, decimal numbers are used throughout and can be displayed to the operator as such at any time. Secondly, the simplified language of the PEGASUS/SIRIUS Autocode, allows it to be used by staff after a short introductory course. Since the latest model was introduced in 1960, ten SIRIUS computers have been ordered. SIRIUS computers will be available for use at Ferranti offices in London, Manchester and in Australia.

The New Paragon High Speed Decollator

The speedy decollation of one-time carbon sets of multi-copy continuous stationery after processing, is an essential factor in the smooth operation of fast computer output printers. Where continuous one-time carbon sets are used it is usually necessary to remove the one-time carbon after the forms have been processed by the printer. The operation of carbon removal is one that must be simple and speedy and to this end, the new Paragon high-speed Decollator has been developed by *Lamson Paragon Ltd.*

Suitable for forms up to 12 in. deep and operating at a speed of up to 300 feet per minute with a variable speed control, the new Paragon Decollator is simple to operate. Forms in continuous length are drawn up by abrasive rollers. The carbon paper is fed through a split roller which can be easily detached for disposal of the carbon paper without mess, in a compact form.

One carbon is removed during each run of the decollator and multi-part sets are decollated by subsequent operations. A four-part set would be broken down into two two-part sets and each two-part set then broken down to a single length of continuous forms. Forms and carbons *must be loose* when used on the new Paragon Decollator, the exception being Hooklock make-up, which is, of course, merely a temporary fixing of forms and carbons. Either Hooklock or "Paraflex," with strip-off stub (another recent Lamson Paragon development) is particularly suitable.

Where floor space is at a premium, it is a factor for consideration that the new Paragon Decollator occupies an area of approximately one square yard.

Aircraft Load Control

The first electronic computer system in the world for aircraft load control and passenger check-in has been brought into operation by Scandinavian Airlines System at Kastrup airport, Copenhagen. Designed, manufactured and installed jointly by *Standard Telephones and Cables Ltd., London*, and its associated company, *Standard Elektrik Lorenz, Stuttgart*, this system, which has cost about £100,000, has been designed to the special requirements of SAS.

For modern airlines it is very important to know for each passenger, what weight of baggage he has, and where it is to be loaded in the aircraft. Knowing the number of passengers and their combined baggage weights it is possible to obtain an overall picture of the total load to be carried by the aircraft and the distribution of this load. When these figures are available in time, the operating airline is able to use spare capacity by loading and carrying revenue earning freight and/or mail.

For this information to be of any value it must be speedily available at some given time before take-off. With a manual system, either the number of check-in points must be limited, or passengers must present themselves and their baggage an inordinately long time before take-off, otherwise a very expensive system of document handling must be introduced.

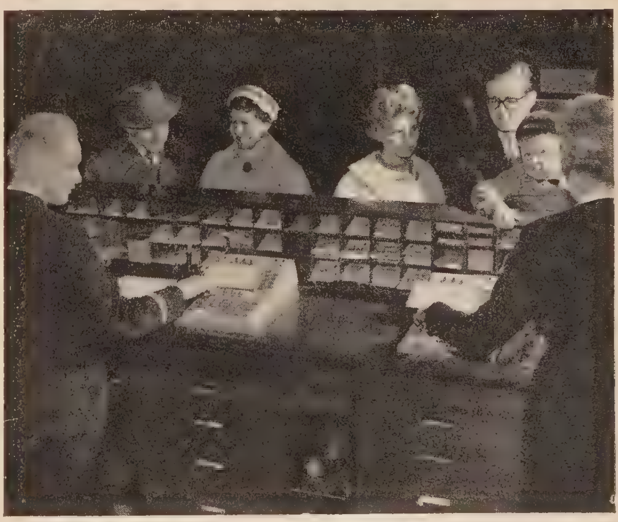
The new electronic computer system collects check-in data from all counters, computes and totals this data to provide the information needed for the compilation of aircraft load sheets, and prints out load sheets, load messages, etc., for each destination of every flight departing from Kastrup.

The advantages of such a system are:

(*a*) Freedom to check-in at any counter for any flight.
(*b*) Instantaneous collection of data from all check-in points.
(*c*) Flexibility of calculation so that the different requirements of different aircraft can be catered for by high speed computation of load data.
(*d*) Since there is no manual intervention between the actual check-in and the production of results, there is less chance of error.
(*e*) Results are available quickly, enabling a more economic loading of the aircraft (e.g. more freight can be carried).
(*f*) The system is capable of expansion and extension.

The equipment consists of the Stantec Zebra computer (providing the central control, the data storage and the necessary computational facilities) connected to input sets at the check-in counters, and master sets (for input and output) at Load Control. The keysets at the check-in counters are similar in appearance to those already in use in the SAS electronic seat availability system, but have facilities for keying in baggage weight and the various categories of passenger.

The master sets at Load Control, which are also push button devices, are used for the input of basic aircraft data, and the output (either on a visual display or a printer) of load status and seat status reports together with load sheets and load messages for onward transmission to each destination of the flight concerned.



A typical check-in point for passengers at Kastrup airport

CORRESPONDENCE

Letters from readers are welcomed, and should be addressed to the Editors, The Computer Bulletin, Finsbury Court, Finsbury Pavement, London, E.C.2. The name and address of the writer must be given, but will not be published if requested.

Extension to ALGOL

Sir,

Having just been introduced to ALGOL 60 at the recent course given at the Automatic Programming Information Centre, Brighton, England, I am filled with a mixture of enthusiasm and disappointment. ALGOL represents a major advance as an automatic programming language but with regard to matrix, complex and multiple length arithmetic it does not go far enough, indeed, not as far as the machine code of one computer which will shortly be available. Its limitations in these respects may well prove a serious hindrance in persuading many computer users to adopt it. ALGOL 60, apart from its potential universality, does not provide for a sufficiently great advance beyond the facilities which are available to those who already have a good autocode; nor does it cater directly for those whose work frequently involves matrices, etcetera.

What is required is a universal computer language which will deal with real numbers and integers in a simple and logical manner (as ALGOL does) and which can be extended to deal with any other mathematical quantities which may be required in an equally simple manner. It should be such that the presentation language follows as closely as possible the usual conventions of writing mathematics and, furthermore, it should be such that the compiler can be built up stage by stage first to deal with real numbers and integers then adding as required complex, multiple length, matrix and any other sort of arithmetic desired.

I hope to be able to show that ALGOL 60 can be made to meet the most of these requirements, by a simple extension of its basic structure. First let it be noted that, although in ALGOL the arithmetic only deals specifically with integers, real numbers and booleans there is no fundamental reason why it should be limited to these quantities. *In fact it could be taken to apply to any set of entities for which the basic arithmetical relations were defined.* Such an entity could be a boolean, an integer, a real number, a complex number, a vector, a matrix, and any of the last five using single, double or triple length precision. A statement could use any combination of these but the compiler would have to interpret the basic operations according to the nature of the operands as, indeed, is already done in ALGOL 60. For example the statement

$$x := a + b;$$

would be translated differently by the compiler according to whether x, a, b are declared to be integers or real numbers.

I would therefore propose that an extension to ALGOL 60 be considered along the lines indicated below.

Further types should be introduced to cover all the entities which we can foresee might be required. The type would consist of three elements stating respectively the nature of the variable, whether real or complex, and the degree of precision required.

This is the only change to ALGOL 60 itself which is necessary. The remaining changes would affect the compilers. The compiler would have to distinguish between arrays, numbers and integers, real or complex, single or double length, and, in the case of arrays carry a note of their dimensions. It would then have to assign a meaning to the operator in question, according to context, following the usual conventions of written mathematics.

The full implementation of such a scheme would take some time; however, these additional types need only be introduced singly and *provided the basic compiler has a suitable structure* this should mean adding to it rather than re-writing it.

Here is a program for finding a latent root of a real non-symmetrical matrix to double length accuracy as it might be written with the above extension of ALGOL 60.

```
begin  integer R1 n;
       n: = READ;
begin  array R1  A [1 : n, 1 : n]; array C2 y [1 : n];
       number C2 q, r          ; number R1 e    ;
       A: = READ; y: = READ; e: = READ;
for q: = T(y) × A × y/(T(y) × y) while DET(A–q)>e do
begin y: = A × y/q; r: = q; end PRINT(r) end end
```

Notes:

R1 implies elements are real, single length

C2 implies elements are complex, double length

e is a small positive number

A: = READ; means read the next (n^2) numbers and store as the array A.

y: = READ; means read the next (n) numbers and store as the column vector y.

T(y) refers to an array procedure for forming the transpose of a vector or matrix. DET(A) refers to a procedure for forming the determinant of A. Both these procedures would be on the standard list.

The arithmetic operators are to be interpreted by the compiler in the usual way (for matrices) with one exception. If a scalar occurs where an nxn matrix is expected, it is as though that scalar were multiplied by the unit matrix. Thus the minus in A–q means subtract q from every diagonal element of A and the statement A: = O; means set A to be the null matrix.

Thus one change considerably extends the scope of ALGOL. Some other minor changes which would improve the presentation would be

(*a*) Permitting to set the value of a vector or matrix thus: y: = (2·5, 3, 0, 0, 1, 0, 0, 0);

(*b*) Having same standard value attached to certain identifiers, e.g. $i = \sqrt{-1}, I = 1, \pi = 3{\cdot}14159\ldots$ etc.

(*c*) Extending the notation to permit the programmer to write y' for the transpose of y, $\bar{z}$ for the complex conjugate of z, $|z|$ for the modulus of z, and $|A|$ for the determinant of the matrix A.

With the above additional changes the principal statement of the latent root programme could be written:

```
for q: y' × A × y/(y' × y)   while |A – q × I|  >e
begin y: A × y/q; r: = q     and PRINT (r) end end
```

[*continued on p.* 9]

NEW-GENERATION COMPUTER EXHIBITION WILL FEATURE MAJOR ADVANCES

Emphasis expected to be on Business Applications

A first preview of the Electronic Computer Exhibition to be held at National Hall, Olympia, London, 3–12 October 1961.

Taking as its theme "The work of the new generation of computers," an Electronic Computer Exhibition will be held at the National Hall, Olympia, London, from 3–12 October 1961. It is being organised jointly by the Office Appliance and Business Equipment Trade Association and the Electronic Engineering Association.

Computers which can perform several tasks at once; methods of feeding information into a computer from a distant factory; automatic reading of letters and figures on cheques and business documents; auto-code procedures for simplifying programme instructions to computers—these are some of the features to be expected, which have been revealed by a preliminary survey conducted in March 1961. The survey was conducted by a division of *F. C. Pritchard, Wood and Partners Ltd.*, public relations consultants to the organisers. All of these features represent major advances since the last exhibition was held in London in 1958. With so much information available at the present stage, the consultants expect that a number of further interesting developments may be announced before October.

The trends revealed from a questionnaire circulated by the agents to exhibitors are towards techniques streamlined to match up-to-date business methods. Systems involving computers and ancillary equipment are being designed to accept and process basic business information in its original form with a minimum of translation and adaptation.

The new types of output printer will be shown at the exhibition, producing business documents at the rate of hundreds of lines per minute, together with summaries and reports demanding day-to-day action by management. Other displays will demonstrate new applications of digital and analogue computers in scientific and industrial research.

Eight computer manufacturers (*AEI, English Electric, IBM* (*UK*), *ICT, LEO Computers, National Cash Register, Standard Telephones and Cables* and *Ferranti*) will be making arrangements to take names on their stands for subsequent visits to actual installations of their customers. Other companies are in process of making similar arrangements.

Many exhibitors were still in process of deciding what to feature on their stands; first promises of new techniques to be displayed and demonstrated included:

"The development of reliable high speed magnetic tape storage systems to the stage where accountants and auditors are prepared to accept non-visible recording of information." (*English Electric Co. Ltd.*)

"Transmission of 5, 7 and 8 unit computer codes with automatic error detection and correction." (*Automatic Telephone and Electric.*)

"A service bureau for the regular analysis of figures produced on punched tape by cash registers and other business machines." (*Ferranti.*)

"A system of printing cheques, hire purchase slips, etc., with perforated figures which, while legible to the human eye, can also be 'read' automatically by a machine." (*Original Document Processing Ltd.*)

"An electromechanical system of processing several hundred orders per day and producing all related paper work under the control of one operator." (*Creed.*)

"The control of aircraft loading and passenger-seat reservations." (*Standard Telephones and Cables.*)

Exhibitors have indicated that the principal developments since the last Computer Exhibition in 1958 have been designed towards cutting down cost, meeting the needs of the smaller business, utilising computer time more fully and ensuring greater flexibility of equipment.

In addition to British made equipment, the original list of exhibitors indicates that American, French and Italian equipment will also be exhibited. The following table has been compiled by the associate editors from the information made available by the Agents, and from general knowledge of the principal business of the companies who are exhibiting: it is subject to revision, when more details are received.

Preliminary Classification of Exhibitions

(*Based on List*—20 *April* 1961)

	Number of Stands	*Total Area (square feet)*
Electronic digital computer and punched card machinery manufacturers; including ancillary equipment by them	10	23,634
Analogue, analogue/digital, instruments, recorders, transistors, valves, transmission equipment	12	7,913
Computer-aided office machinery	2	4,030
Printers, teleprinters, paper-tape preparation equipment, data transmission	6	3,779
Specialist magnetic-tape and drum manufacturers	5	1,793
Output stationery, form feeders, etc.	3	1,410
Banking, finance	3	1,107
Journals and textbook publishers	4	585
Total	45	44,251

All Exhibitors are invited to send full details of their planned and expected exhibits to Mr. H. W. Gearing, c/o The Metal Box Company Ltd., 37 Baker Street, London, W.1, to arrive not later than Friday, 21 July 1961.

A revised table and a preview of the Exhibition will be published in the September issue, based on the information received by the associate editors from manufacturers, their agents, and the organisers.

Notes on the Submission of Papers

Communications. Papers submitted for publication should be sent to one of the honorary editors: E. N. Mutch, The University Mathematical Laboratory, Corn Exchange Street, Cambridge, *or* H. W. Gearing, c/o The Metal Box Company Ltd., 37 Baker Street, London, W.1. They will then be sent to members of the Editorial Board who will advise on subjects within their particular experience. The author will be informed as soon as possible whether the paper has been accepted for publication, the date of the journal when it will probably appear, and of any modifications suggested by the referees.

General. Submission of a paper to the Editorial Board will be held to imply that it is an original article not previously published; that it has been cleared for publication so far as military or commercial secrecy is concerned; that it is not under consideration for publication elsewhere; and that if accepted for *The Computer Journal* it will not be published elsewhere in the same form, in English or any other language, without the consent of one of the Editors.

Contributors who reside outside Great Britain are requested to nominate somebody in Great Britain willing to correct their proofs. Papers from such contributors should be accompanied by a statement of the number of reprints required.

Authors' names should be given without titles or degrees. Women are requested to give one Christian name in full to avoid confusion. The name and address of the laboratory or other institution where the work was performed should be given.

Typescripts should carry the name and address of the person to whom the proof of the paper is to be sent and should also give a shortened version of the paper's title, not exceeding forty-five letters and spaces in length, suitable for a running title in the published pages of the work.

Form of papers submitted for publication. The onus of preparing a paper in a form suitable for sending to press lies in the first place with the author. Proper attention to detail in the preparation of the typescript before it is sent to the Editors will shorten the time required for publication. Papers not in satisfactory form may have to be returned to the authors for revision.

Papers should be in double-spaced typing on one side of sheets of uniform size with large margins. A top copy and one carbon copy should be submitted. Each paper must be accompanied by a summary of its contents which will be printed immediately below the title at the beginning of the paper. Pages should be numbered consecutively in arabic.

Footnotes. These should be typed immediately below the line to which they refer. The sheet should be ruled in ink for its whole width above and below the footnote. Footnotes should be used sparingly and should be brief.

Tables. Each table should be numbered consecutively in arabic and should have a general heading typed at the top, as well as the necessary headings to columns, etc. Column headings must be sufficiently brief to permit convenient setting up in type. Careful attention should be paid to layout so as to avoid tables of excessive width; the printing area of the *Journal* page is 7″ × 9″, in two columns. Headings should be chosen so as to make the tables as far as possible comprehensible without reference to the text. Tables should not normally be included in the text but should be typed on separate sheets. More than one table may be included on a single sheet, but tables should not be split between sheets. Their approximate position in the text should be indicated in the margin of the text.

Mathematical formulae. These must be clearly written, avoiding symbols or arrangements which are difficult to set up.

Figures. Simple diagrams and flow-charts involving only a few lines may be set up in letterpress at the discretion of our printers. Directional arrows must be clearly indicated. Most diagrams will, however, require to be photographically reproduced.

Where a diagram involves curves, diagonal rules, or other detail which cannot be set up in type, it must be well drawn in indian ink and clearly lettered on plain white paper, Bristol board or faintly blue-lined paper. The diagram should be approximately twice the size of the finished block. The size limits for finished blocks are: *width,* single-column 3¼″, double-column 7″; *depth* 9″. Each diagram should be on a separate sheet, packed flat and bearing the author's name on the back.

For photographs, glossy prints are required; clips should not be used and care should be taken to avoid heavy pressure when writing on the backs.

Figures should be numbered consecutively. Legends should be so written that the figures are as far as possible comprehensible without reference to the text. The approximate position of the figures should be indicated in the margin of the text.

In cases of doubt, a rough draft should be sent to one of the honorary editors for a decision as to the best method of reproduction, before the fair copies are prepared.

References. These should be given in the text thus: Barnett and Robinson (1942), (Culbertson and Thomas, 1933); where a paper to be cited has more than two authors, the names of all the authors should be given when reference is first made, e.g. (Osborne, Mendel and Ferry, 1919); subsequent citations should appear thus (Osborne, *et al.*, 1919). Where more than one paper by the same authors has appeared in one year the reference should be given as follows: Osborne and Mendel (1914*a*); Osborne and Mendel (1914*b*); or Osborne and Mendel (1914*a*, *b*); (Osborne and Mendel, 1914*a*, 1916; Barnett and Robinson, 1942). At the end of the paper references should be given in alphabetical order according to the names of the first authors of the publication quoted, names with prefixes being entered under the prefix, and should include the author's initials, year of publication, title of paper, the name of the journal, volume and first page number. References to books and monographs should include year of publication, the title and edition, town of publication and the name of the publisher. Examples:—

CRANDALL, S. H. (1954). "Numerical Treatment of a Fourth Order Parabolic Partial Differential Equation," *J. Assoc. Comp. Mach.*, Vol. 1, p. 111.

ROYSTER, W. C., and CONTE, S. D. (1956). "Convergence of Finite Difference Solutions to a Solution of the Equation of the Vibrating Rod," *Proc. Amer. Math. Soc.*, Vol. 7, p. 742.

CRANDALL, S. H. (1956). *Engineering Analysis, A Survey of Numerical Procedures.* New York: McGraw Hill Book Co.

Authors are asked to check their references for accuracy before submission of the paper.

Proofs. The authors are responsible for seeing that their typescripts are in final form for publication. Proofs are sent to authors in order that they may make sure that the paper has been correctly set up in type, and not that they may add new material or make corrections to the text. Otherwise increased printing charges are inevitable. Excessive alteration may have to be disallowed. The symbols used to indicate corrections should be those laid down in British Standard 1219: 1945; a shortened version is also published (B.S. 1219*c*: 1945, 1s. 6d.).

Reprints. Twenty-five reprints are supplied free of cost. Additional reprints may be purchased if the Editors are notified on the appropriate form when the proof of the paper is returned.

Editorial

WHAT'S IN A NAME

Now that the Board of Trade have granted the Society a licence to dispense with the word "Limited" in its name, the third feature sought by the Society's founders has been achieved.

So that the Society might have a corporate being and be recognised as a legal entity, its founders wisely formed a company limited by guarantee, under the various rulings of the Companies Acts then in force. But Parliament, through the Board of Trade and the Registrar of Companies, exercises strict control not only over the constitution of companies as evidenced in the memorandum and articles of association, but also over the choice of name.

The word "The" is not normally favoured. It gives the company an air of individuality which in the normal commercial sphere might in time come to be misleading. It implies that the organisation is the only one of its kind, that it is unique, and that there is little likelihood of a similar organisation disputing the fact that the original registration denotes the senior body. The Society's claim to be the only Society of this kind in the country, and to represent indeed the whole computing field, was accepted.

Use of the word "British" is jealously guarded. In negotiations overseas, in all branches of foreign trade, it can attract a flavour of a semi-official title. The Society's further claim that they do in fact represent the British point of view internationally in all aspects of the computing art was also accepted, and it is with pride that the Society was able to be registered as a limited company under the full title of "The British Computer Society Limited".

In professional circles, however, the necessity to use the word "Limited" introduces an unwarranted commercial flavour, and the Society has long sought to achieve the third distinction, normally permitted only to organisations of some standing and tradition, to dispense with this word. That this has been achieved in the comparatively short life of the Society is a tribute to its deeds and ideals, to the respect which its Council and other representatives have commanded, and to the wise counsel of The British Computer Society's advisers.

SOCIETY AND COUNCIL NOTES

Annual General Meeting

By the time this issue of *The Computer Bulletin* has been published, members will have received the Annual Report and Accounts for the year ended 30 April 1961 and a notice of the Annual General Meeting.

This is to be held at the Northampton College of Advanced Technology, St. John's Street, London, E.C.1, at 6 p.m. on Tuesday, 26 September.

Following the business of the Annual General Meeting, there will be an ordinary meeting of the Society when Dr. F. Yates, F.R.S., of Rothamsted Experimental Station, will give a talk on "Computers in Research—Promise and Performance." This will be the valedictory address of the Society's retiring President.

The Society's New President

Council have appointed Mr. D. W. Hooper, M.A., F.C.A., as President of the Society for one year in succession to Dr. F. Yates.

Mr. R. L. Michaelson, F.I.A., F.I.S. (a Vice-President and retiring Member of Council) has been appointed Chairman of the Executive Committee and Deputy Chairman of Council in succession to Mr. D. W. Hooper.

Vice-Presidents

Dr. F. Yates has been appointed by Council a Vice-President for five years in the first instance, on his retirement as President. Two other Vice-Presidents have been appointed by Council, also for five years in each case: Mr. A. Geary, M.A., M.Sc., in recognition of his continuing efforts on behalf of the Society in the field of education and for his great assistance in many fields throughout the Society's history, and Mr. H. W. Gearing, B.Sc.(Econ.), F.C.I.S., F.I.S., to mark the hard and unremitting work he has performed for the Society since its formation. Mr. Gearing has also been appointed Deputy Chairman of the Executive Committee.

Honorary Officers

The Society is fortunate in being able to make use of the generous help of Honorary Officers. Mr. E. C. Clear Hill, B.Sc.(Eng.), A.C.G.I., D.I.C., A.F.R.Ae.S., has offered to continue for a further year as the Society's Honorary Secretary, and Council have gratefully accepted this. Mr. H. W. Gearing has asked to be relieved of the post of Honorary Treasurer in view of his many other commitments (he is one of the Honorary Editors of *The Computer Journal*, among other things) and Mr. R. M. Paine, B.A.(Econ.), has kindly consented to accept this post for the ensuing year.

COMPUTER COMMENT

Symbolic Languages

The Provisional International Computation Centre is organising an international symposium on "Symbolic Languages in Data Processing," to be held in Rome on 26 to 31 March 1962. The symposium is expected to include lectures on individual studies, panel discussions, and working parties for the study of universal languages. Languages considered will include those used for numerical analysis, commercial purposes, automatic translation, and the processing of non-numerical information. The address of the Centre is Palazzo degli Uffici, Zona EUR, Roma, Italy.

IFAC Congress 1963

The second congress of the International Federation of Automatic Control (IFAC) will be held in Basle, Switzerland, in September 1963, at the invitation of the Swiss Association for Automatic Control. A committee of the British Conference on Automation and Computation will co-ordinate the submission of papers from the United Kingdom to the congress.

Most of the papers will deal with the theory or application of automatic control; a number will deal with the components of control devices. Subjects to be covered are as follows: *Theory:* discrete systems; stochastic systems; optimal systems; learning systems; systems reliability. *Applications:* process dynamics; computer studies of applications, on or off line; optimising or adaptive control applications. *Components:* new and effective devices; measurement of the reliability of components.

Papers may be submitted in English, Russian, French or German. The final version of any paper by a United Kingdom author should be in the hands of the BCAC committee not later than 1 June 1962, for transmission to the International Selection Committee of IFAC during August 1962. The Executive Council of IFAC have ruled that the number of papers shall not exceed 100.

Offers of papers from the United Kingdom should be made to the Honorary Secretary, BCAC, c/o The Institution of Electrical Engineers, Savoy Place, W.C.2. General inquiries concerning the congress arrangements should be made to the Secretary of IFAC, Dr.-Ing. G. Ruppel, Prinz-Georg-Strasse, 79, Dusseldorf, Germany.

Television Quiz Champions

Three persons are the undefeated champions of Associated Television's quiz game "Pencil and Paper"—Graham Morris, Christine Willies and Michael Fletcher, who are all employed at the Putney Computer Centre of *International Computers and Tabulators Ltd.* They competed successfully against teams of solicitors, contraltos, bridge players, racing correspondents, educational psychologists and others for some 15 weeks at the Birmingham studios of ABC Television and then retired unvanquished.

The wife of Glamorgan-born Graham Morris was programme hunting about nine months ago, when she switched, quite by chance, to "Pencil and Paper". She mentioned the programme to her husband, who is deputy manager of computer applications with ICT and, after looking-in a few times, he suggested to his colleagues at work that the firm might put up a team.

As often happens, the man with the idea gets the job—or part of it—and from 28 February, in front of some nine million viewers each week, Graham Morris and his fellow "computer programmers" took on all-comers. Not one of the ICT team was a regular viewer of "Pencil and Paper" before taking part, and they fully expected to be beaten each week. But they survived the general knowledge and intelligence tests, gaining confidence with each week's success.

In spite of their successes, this team of quiz veterans are by no means smug about the results. They say that there is a basic difference between playing at home and before the cameras. Questions about shapes are easier for the viewer who gets a clear picture, whereas the team has the advantage when the problem is numerical and they have the questions written before them and are provided with paper on which to make their calculations. The producer of the show always regrets that, by keeping the problem on the screen when the team members are in their separate agonies, praying for inspiration, viewers cannot share this amusing ordeal.

Perhaps the most significant aspect of the programme is that it really is a good family game in which parents score well in general knowledge, because of their experience, whereas children do well in the intelligence tests due to their training at school.

THE SIMULATION OF THE ORION TIME-SHARING SYSTEM ON SIRIUS

by H. P. Goodman

The Orion time-sharing system—as originally envisaged—may lead to inefficient running with certain combinations of programs. A simulation program has been written for Sirius to investigate methods of improving the time-sharing, and also to examine the advantages of time-sharing between two branches of the same program. This paper is based on a talk given to The British Computer Society in London on 15 February 1961.

The Orion Time-sharing System

Orion is a medium-to-large computer with full time-sharing facilities. The system works partly by hardware and partly by program, so it is possible to make modifications in the light of experience.

There is virtually no limit to the number of programs that can be run simultaneously. In the time-sharing system originally envisaged, these programs are arranged in a list with those programs that are severely limited by peripheral equipment at the top of the list, and programs that are mainly mill-limited at the bottom of the list—the term "mill-limited" is used to describe programs that are calculating most of the time and only do occasional peripheral transfers.

There are two types of interruption:

(*a*) time-sharing interruptions;
(*b*) monitoring interruptions.

Monitoring interruptions are those that cause entry to the organization and monitor program for such events as program or peripheral-equipment failures or intentional entries to request special actions—they will not be considered further in this paper.

Time-sharing interruptions are of four types:

(i) *Peripheral lock-out.*—This occurs when a program refers to a busy (or disengaged) peripheral device. In some cases several peripheral devices may be connected to a common control unit—for instance, paper-tape readers and punches. If one of these devices is busy then the others cannot be used, so a program referring to such a device will be locked-out until the control unit is free.

(ii) *Core-store lock-out.*—This occurs when a program refers to a core store location which is involved in a reading transfer, or attempts to write to a location involved in a writing transfer.

(iii) *End of transfer.*—This occurs when a peripheral device has completed a transfer. This causes an interruption, so that a program which has been waiting for that device, or its control unit, can be re-entered.

(iv) When one second has elapsed since the last interruption. This is for protection against certain rare cases where an end-of-transfer interruption is missed due to two transfers ending almost simultaneously; a low priority program might be entered and not get interrupted, although a higher priority program is ready to run.

In each case the link (i.e. return address) and requirement of the program just left are stored, and the program cannot be re-entered until its requirement is free. In case (i) the requirement is the peripheral device referred to, in case (ii) it is the core store location referred to, and in cases (iii) and (iv) there is no requirement.

The form of the simple time-sharer, to be referred to as *Time-sharer Mk.* 1, is illustrated in Fig. 1. The programs at the top of the list initiate many peripheral transfers and spend most of the time locked out on peripheral devices (or the core store), thus allowing the lower, mill-limited programs to proceed.

The Problem of Clashing

Difficulties arise with the Mk. 1 time-sharer if two programs use the same peripheral device. This can in fact only happen in the case of the drum, but the same effect occurs if two programs use devices connected to the same control unit. Consider the following simple case—with just two programs in the machine. Program A is drum-limited—e.g. a program that requires a random-access store larger than the available core store. Program B is mill-limited—it calculates nearly all the time but occasionally requires access to the drum to write up some results or to read down some fresh data. These programs appear compatible and should between them keep both the mill and the drum busy full time.

What happens, however, is that the programs interfere. Program A is entered and uses the drum. It then tries to use the drum again, gets locked out and program B is entered. Program B calculates until A's first transfer is finished, when there is an end of transfer interruption and A is entered. A does its second transfer and gets locked out on attempting to initiate a third—letting B in again. This process continues until B tries to use the drum. B then finds that the drum is busy

(i) Store link and requirement of program just left.
(ii) Scan programs in fixed order to find first one ready to go.
(iii) Enter program found.

Fig. 1. Orion—Simple time-sharer

**

doing A's transfer and B is therefore also locked out. The computer is now idle until A's transfer is finished; A then initiates another transfer and is subsequently locked out. B thus still fails to get in as it is still waiting for the drum. B never gets in again and the computer is idle between A's transfers.

To avoid this difficulty it is necessary that B should be able to get at the drum whenever it requires it; in general the requirement is that a program which makes little use of the mill should normally be entered if ready to go, but if a mill-limited program is waiting for a device it only uses occasionally then it should be entered. Considerable thought was given to the best method of achieving this and it was eventually decided to introduce the concept of a chronological peripheral queue (Fig. 2). When a program is interrupted the time-sharer inserts the program at the end of this queue if the interruption was caused by a peripheral lock-out. The time-sharer now scans the peripheral queue, though it will probably only find a program ready to go in the queue if the interruption was caused by end of transfer. If there is no program in the peripheral queue that is ready to go, the time-sharer now scans the normal list as in Mk. 1. This time-sharer will be called Mk. 2; it ensures that every program gets a chance to initiate its transfer in turn and hence that no program can lock-out another one permanently.

The Simulator Mk. 1

The consequences of the Mk. 2 time-sharer are far from obvious when several, possibly complicated, programs are running simultaneously; so we decided to write a simulator. It is unnecessary for the simulator to simulate the Orion instruction code in detail, only the time-sharing properties are needed.

A Sirius computer was available at the Ferranti London Computer Centre, Newman Street, and proved very suitable for the purpose. Sirius is a small decimal computer with 1,000 words of storage (which proved sufficient), paper tape input and output, and a digital decimal display. The Sirius initial orders accept instructions written as four decimal digits followed by space and a six-digit address—the latter may be omitted if zero. It is therefore convenient to write the simulated instructions in the same form to avoid writing a special input routine. The instruction code used is shown in Fig. 3. There are assumed to be up to nine peripheral controls numbered 1–9, but output only occurs for up to the highest-numbered control used. The interval between outputs is set on the decimal keyboard in milliseconds; the output consists of the time used by each program on the mill and on each control. Up to nine programs can be run simultaneously and all programs must terminate by an unconditional jump or a suspend instruction. The order of the programs on the input tape is the order of priority assumed—each program being terminated by L. Thus the simple case described above (taking control 1 as the drum) can be represented as follows:

```
┌→0000  10
│ 0010  100
└─0102
  L
┌→0000  100
│ 0010  10
└─0102
  L
```

This version of the simulator does not simulate core-store lock-outs as it is chiefly intended to study the effects of peripheral lock-outs. Simulator Mk. 1.1 uses time-sharer Mk. 1, and Mk. 1.2 time-sharer Mk. 2.

Further Difficulties—Program G

The program given above was run on the simulators Mks. 1.1 and 1.2. With 1.1 the second program soon got locked out on the drum and the efficiency of mill utilisation was 10%. With Mk. 1.2, the improvement was to 45% which is still disappointing. The reason is as follows: program A is locked out on the drum and therefore has an entry in the peripheral queue, when program B gets locked out it is entered second in the peripheral queue; B therefore has to wait until A completes its current transfer and does one more transfer before B gets in. This can be cured by the following modification: we introduce a bottom priority program, called program G, which is entered whenever no other program is able to run. Program G simply takes the bottom entry from the peripheral queue and puts it to the top—thus letting B in as soon as A's transfer is complete. This device produces an improvement in every case run so far. The time-sharer with program G is Mk. 3 and is used in the simulator Mk. 1.3. In the above case the mill utilisation with Mk. 1.3 becomes 58%. This low figure is largely due to the accident of

Store Link and requirement of Program just left.
Is requirement peripheral lock-out?
If so, insert program at end of peripheral queue.
Scan peripheral queue.

FOUND	NOT FOUND
Delete entry from peripheral queue. Move subsequent entries up one. Enter program.	Scan main list (i.e. fixed order). Enter program found.

Fig. 2. Orion—Complex time-sharer

0000	*N*	Calculate for *N* msecs.
00*a*0	*N*	Start a transfer on peripheral control *a* lasting *N* msecs.
01*ab*		Unconditional jump back *ab* instructions.
01*ab*	*N*	Jump back *ab* instructions, counting up to *N*.
0200	*N*	Reset count in previous instruction to *N*.
0300		Suspend the program.

Fig. 3. Simulator Mk. 1 instruction code

the numbers in the program—it so happened that B always tried to initiate a transfer 1 msec after A had started one, so that it had to wait 99 msec before it got in. The case was re-run with B referring to the drum less often, and the mill utilisations for the three time-sharers became 10%, 78% and 89%.

More Complicated Cases

Several more complicated cases were run on the various versions of the simulator and two of them are described below.

Table 1 gives gives the results for case 2 where there are three programs, all of which use the drum and two of which use paper tape—it is assumed that the output punch used by program A and the tape reader used by program B are on the same control unit. The programs were run with all three time-sharers (shown in the first

Table 1

Simulator Mk. 1. Case 2

TS	ORDER	MILL	DRUM	P.T.
		%	%	%
1	ABC	25	99	12
1	BAC	96	2	98
2	ABC	91	96	91
2	BAC	93	95	90
3	ABC	94	97	91
3	BAC	94	95	92

PROGRAM A—Drum limited outputs occasionally.
PROGRAM B—Input routine, tape limited—writes to drum occasionally.
PROGRAM C—Base load—uses drum occasionally.

column under TS), and in the two orders of priority ABC and BAC (there is no point in trying program C as top priority as it would never get locked out). With the Mk. 1 time-sharer in the order ABC, programs B and C both get locked-out on the drum after an initial period, and the low mill and paper tape utilisation figures reflect the utilisation by A alone. In the order BAC program A gets locked out on paper tape, but B and C go—hence the low drum utilisation figure. With time-sharers 2 and 3 all three programs go and the order of priority makes little difference. Note that the figures for time-sharer 3 are slightly better than those for time-sharer 2. As the order of priority between A and B makes little difference the allocation of priority becomes less critical; since it is often difficult to allocate priorities accurately this is itself an argument in favour of the complex time-sharer.

The third case is shown in Table 2 and is meant to illustrate a typical commercial load. The main job is program B, which is up-dating a low activity file and is usually magnetic-tape limited. When program B has to process an amendment it has to get another chapter of program from the drum and obey it. Program A is a pseudo off-line job which is printing out a magnetic tape—it uses virtually no mill-time and is heavily printer-limited. With just these two programs it made very little difference which time-sharer was used since the programs do not interfere with each other to any significant extent. The mill is used less than half the time as both programs are peripheral-equipment limited. If, however, a base-load program is added this goes very much better with the complex time-sharer, and the mill is used over 90% of the time at the expense of a slight reduction in magnetic tape efficiency. The results from time-sharer Mk. 3 were almost identical to those from Mk. 2 and they have therefore been omitted from Table 2.

Table 2

Simulator Mk. 1. Case 3

TS	MILL	DRUM	MAGNETIC TAPE	PRINTER
	%	%	%	%
1	45	28	79	99
2	46	28	79	98
WITH BASE LOAD				
1	76	35	79	99
2	91	35	76	98

PROGRAM A—Magnetic tape to line printer.
PROGRAM B—File updating—Low activity.
Both B and the base load use the drum.

Master and Slave Techniques

On Orion it is possible to use time-sharing between two branches of the same program. It is usual to regard one branch as the master and the other as a slave—the slave is usually operating a peripheral device. A good example where this technique is useful is a program producing information to be printed on a line printer. The program may take 1 second per case, at the end of which ten lines are available to be printed—these all becoming available simultaneously. The printer operates at ten lines per second, so one wishes to keep the mill and the printer both fully occupied. If one tries to feed out these lines one after the other, one will be locked out on each line after the first so there is very little advantage from the autonomous transfer facilities. An alternative is to scatter print instructions through the program at approximately 100 msec intervals but this will rarely be satisfactory. The solution is to have a slave program—the master program fills a buffer in the core store and the slave empties it using time-sharing, while the master is doing the next case. Special instructions are provided to ensure that the two branches of the program do not get out of step.

A more complicated case is the file updating job discussed above (Table 2). The processing of the file keeps up with the magnetic tape (and normally waits for it) unless there is an amendment. Then the tape is held up until the amendment has been processed and the program is ready to initiate another transfer. What happens in fact is that there are three areas of core store the size of the length of tape block being used. The program initiates an input and an output tape transfer (which proceed simultaneously on the assumption that two tape controls are available) and then processes the block just read. The tape is thus held up if the two tape transfers have been completed before the master has finished processing.

If one uses the master-slave technique for this problem one has four or more buffers instead of three (Fig. 4). When there are no amendments the master program is processing the block just read in and there is one block which has been processed and is waiting to be fed out by the slave. When the master finishes processing each block it is suspended until the slave has produced another block to be processed. When an amendment occurs the master is still processing when the slave has finished its current transfer so the slave proceeds to do the input and output of one further block as there is a spare buffer available. If the processing has been finished before these transfers then the master can carry on with the next block. If no second amendment arrives in the next few records the master will catch up and the tape will be kept busy all the time.

The Simulator Mk. 2

If one uses more than four buffers in the above problem the chance of the master program getting so far behind the slave that the tape has to wait is reduced. However, assuming a fixed area of store available for buffers, the length of each buffer is reduced as their number increases,

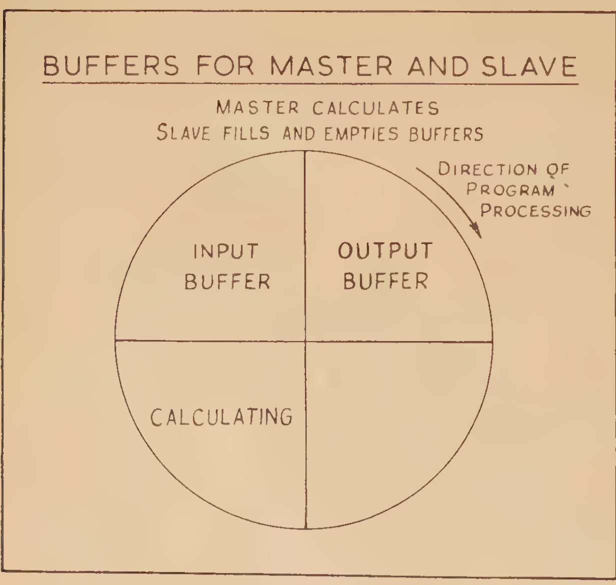


Fig. 4

$000b$	N	Calculate for N msec using core store region b.
$00ab$	N	Start a transfer on control a and core store region b lasting N msec. If $b = 0$ no core store lock-out.
$01ab$		Unconditional jump back ab instructions.
$01ab$	N	Jump back ab instructions, counting up to N.
0200	N	Reset count in previous instruction to N.
0300		Enter Sirius machine instructions at next instruction.
$04a0$	N	Reactivate program a if suspended. Suspend this program if $c(N) < 0$.
0500		Suspend. Not reactivable by 04 instruction.

Fig. 5. Simulator Mk. 2 instruction code

and the tape efficiency suffers accordingly—long blocks on tape are more efficient as there is a fixed length of inter-block gap. It was decided to carry out some experiments on Sirius to determine the optimum number of buffers, and the simulator was rewritten accordingly. The revised instruction code is shown in Fig. 5. The simulation has been made more realistic by the inclusion of core-store lock-outs. There are nine core store regions numbered 1–9, and a program is locked out if it refers to a region involved in a transfer in the same or another program. If two programs are in the master–slave relationship they will use the same core store regions—independent programs will have their own core store regions (this is not checked in the simulator but is checked by hardware in Orion). Reference to core store region 0 will cause no lock-out—this makes it simpler to consider cases where core store lock-outs are unimportant. The 04 instruction is the link between the master and the slave. A counter in location N (where N is a Sirius store location) has one subtracted from it by the master and one added to it by the slave each time round the loop. If the master finds it negative the slave is getting behind and the master suspends itself. A similar instruction is used by the slave to switch the master on again at the appropriate moment.

There is also a facility to enter Sirius machine instructions—these are allocated a range of store locations which they may use and return to the simulator by an appropriate jump. Their main use is to calculate markers used in the 04 instructions, but they have other applications which make the simulator more flexible—for instance genuine conditional jumps can be used and pseudo-random numbers calculated to give the effect, for instance, of a genuine random 2% amendment rate instead of one amendment every fifty records. They are also necessary to modify through a series of buffers by generating and planting suitable 00 instructions.

Results of Simulator Mk. 2

The file updating job with master and slave was run on the simulator with 3, 4, 5, and 6 buffers and with two different amendment rates—the results are given in Table 3. In each case, 1,500 core store locations were assumed to be available for buffers, and the resultant buffer lengths are given in the third column. The case with three buffers is effectively the same as if master–slave

Table 3

Results of Master and Slave Buffering

AMENDS	BUFFERS	BUFFER LENGTH	TOTAL TIME	TAPE TIME	BASE LOAD
%		WORDS	SEC	SEC	SEC
2	3	500	13·2	19·7	4·3
2	4	375	12·9	21·9	3·6
2	5	300	13·1	22·8	3·3
2	6	250	13·4	23·2	3·4
5	3	500	16·9	19·7	6·0
5	4	375	16·5	22·0	5·4
5	5	300	16·7	23·0	5·2
5	6	250	16·6	23·3	4·8

Order of programs: (*a*) Tape to printer; (*b*) Slave; (*c*) Master; (*d*) Base load.

techniques were not used. In each case the same number of records were processed, and the fourth column gives the total elapsed time in each case.

The results were disappointing in the sense that they show that the master–slave technique is not really worth while in this case. The total time was only fractionally better for four buffers than three; in both cases five and six buffers were worse than four. The fifth column gives the total tape-control time used (assuming two tape controls). This increases with the number of buffers due to the reduced efficiency of using shorter tape blocks, but note that even with six buffers the two controls are still not used full time so the tape is still held up on occasions. The last column gives the time left for a base-load program—this may not exist, as in many installations no suitable program is available, and the main load probably uses all the core store. The gain obtained by the master–slave technique is not worth the trouble taken.

Another case investigated was a compiling routine. This required random access to a large number of words; some in the core store, some on the drum, and the remainder on magnetic tape; a tape search is required for the latter. For reading from the tape it is necessary to hold up the master, but writing can be done by a slave. The effects of running the problem as one program or as master and slave were investigated in the two cases of core store references, drum references, and tape references in the ratios 40 : 40 : 20 and 25 : 70 : 5—the results are given in Table 4. Once again the same amount of work was done in each case and the total times are given in the fifth column. They show that the savings made by the master and slave technique are appreciable in this case; the large reduction in time in the last two rows show that the program is heavily limited by tape searches. The last column shows that this compiler uses only a small proportion of mill time and it is therefore highly desirable to run a base-load program with it if a suitable one can be found. However, the advantages of using the master–slave technique are sufficient to make it worth while in this case.

Table 4

Results of Compiler Simulation

CORE REFS.	DRUM REFS.	TAPE REFS.	METHOD	TOTAL TIME	MILL USE
%	%	%		SEC	%
40	40	20	One program	44·4	5·1
40	40	20	Master and slave	39·4	5·8
25	70	5	One program	19·9	12·0
25	70	5	Master and slave	17·1	14·1

Conclusion

In conclusion, it appears that time-sharing is a very worth while facility, but that its detailed effects are so complicated that it is essential to use simulation on a computer to trace them. When Orion is working, these predictions will have to be tested in practice, but it will still be necessary to use some sort of simulator—possibly on Orion itself—to obtain detailed statistics of the performance of the various programs.

* * * *

Acknowledgement

The author wishes to thank Messrs. Ferranti Ltd. for permission to publish this paper.

First B.C.A.C. Annual Lecture

Dr. D. G. Christopherson, O.B.E., F.R.S., Pro-Vice Chancellor of the University of Durham and Warden of the Durham Colleges, has accepted an invitation to give the first annual lecture of the British Conference on Automation and Computation.

He will speak on the subject, "Mathematics—Friend or Foe?" at the Lecture Theatre of The Institution of Electrical Engineers, Savoy Place, London, W.C.2, on Wednesday, 27 September, at 5.30 p.m.

The lecture is open to members of the Society. Tea will be served at 5 p.m.

THE ROLE OF THE ACCOUNTANT IN ELECTRONIC DATA PROCESSING

An address by Eric A. Leslie, Vice-President, Accounting, Canadian Pacific Railway, at the 48th Annual Convention of the General Accountants Association (Canada), Chateau Laurier, Ottawa. 15 *June* 1961.

Introduction

The subject that has been selected is a challenging one. Fortunately, the title is vague as to whether the "accountant" referred to is one who follows the auditing profession or is a person, with or without professional training, who occupies a position in an accounting department such as ours.

In order to address myself to both groups, I have divided the role of the accountant into four main functions:—

One—general accounting and control.
Two—internal audit.
Three—professional external audit.
Four—general business intelligence.

The first three of these functions are changing rapidly, but in more or less traditional fashion. On the other hand, the fourth—general business intelligence—is now undergoing revolutionary changes.

Electronic Data Processing—"EDP"—makes possible a new concept of data processing—Integrated Data Processing or—"IDP." This concept involves much more than simply using new machines to perform old tasks. It can change the whole basis for managerial control. To exploit it properly, one must be prepared to alter one's thinking and approach entirely. Later in these remarks, I will endeavour to point out some of the new horizons which are being opened up and perhaps may be able to bring fresh subject-matter to your attention.

Historical Background

In searching around for material for background which might be of interest, I recalled that I had a copy of an address my father had made to a meeting of your Association on November 14, 1921, entitled "Accountancy Past and Present." In examining it I found he spoke of the barter of the cave man, referred to the invention of coinage in 900 B.C., and the start of accounting in the fifteenth century. His quotations from the first printed work on book-keeping written by a monk of the Order of St. Francis in 1494 referred to Journals and Ledgers. He made mention of the founding of The Institute of Accountants in Edinburgh in 1853, of the American Association of Public Accountants in 1887 and of the start of schools of accountancy. He discussed single entry book-keeping and what he called the rediscovery and development of the double entry system, but for the 2,800 years he covered there was only one reference to labour saving. It was a quote from an early English author which read:—

> "Various devices are constantly being introduced—all directed to the lessening of labour in account keeping and to the simplification of work. Among these may be mentioned the Card Ledger, the Slip System and the Loose Leaf Ledger."

Clearly, at the time he was speaking, mechanisation did not loom large in the general accounting picture. In fact, the *Canadian Pacific* was one of the very few organisations then using punched cards. Incidentally, I still recall vividly, while in high school, being taken in 1912 to see a Hollerith vertical sorter and a tabulator handling 45 column cards with round holes. It was located in a tiny space in the small tower of Windsor Station and was the pride and plaything of the Auditor of Freight Receipts of that day. The variety of business machines increased rapidly in the succeeding twenty-five years and there was a steady growth in use until, in the late 40's, the first electronic computer, a small affair, appeared. The *Canadian Pacific* installed its first in 1949 and considered that a new era had dawned. It was not, however, until 1951 that business data, as opposed to strictly accounting data, commenced to be fed into computers, and it was not until 1954 that any corporation began to use a large-scale unit. During the next three years, as you will recall, growth was phenomenal—some 200 large-scale computers and more than 800 medium-scale types went into service. Now, in 1961, there are some 575 large-scale, and 4,900 medium- and small-scale computers in use. A quite recent development is the appearance of small but powerful transistorised computers that bring an effective EDP system within the cost and requirements range of smaller firms. I am told that one supplier already has 5,000 orders on hand for one type in his line for which first deliveries began this Spring.

The data processing requirements of the big companies seem to demand more and more powerful models and these are becoming available. The *Canadian Pacific*, for instance, is now getting ready for its fourth high-speed computer, an IBM transistorised 7080, due in October. This will be six times faster internally than our present 705 model, and, we expect, will be adequate for many years to come.

That is not to say, however, that the amazing experiments which the research laboratories of business machine manufacturers are conducting with miniaturisation and radically new approaches may not lead to computers more powerful than anything yet created. They have to be thought of in terms of what will fit in an ice-box, since they take advantage of the super-conductivity of certain metals, which is only obtained at temperatures approaching absolute zero!

Equally important developments in two other machine groups have been basic to the new concepts of data processing.

The first group includes the so-called Common Language Machines, consisting basically of an electric typewriter with punch and reader which facilitates the recording of data in mechanical form on paper tapes or cards. This is sometimes done concurrently with the production of page copy and usually much nearer the source of the information than was previously done. These machines can also produce page copy from punched tapes and cards or vary its format. The field of intercommunication between machines in the input area has by these means been greatly broadened.

These machines are becoming increasingly versatile and reliable. Some of the most interesting recent advances are in the new associated equipment for conversion of the input–output media. An example of this is the DYKOR—a machine that we installed last year at *Canadian Pacific* that is one of only half a dozen in operation. It provides high-speed conversion of paper tape to magnetic tape, magnetic tape to paper tape, and magnetic tape to magnetic tape on a selective basis.

The second group is the communication equipment which, by creating signals on a wide range of frequencies, permits the simultaneous transmission of many messages over a single pair of wires, or which transmit through the atmosphere from one point to another, with no direct physical connection. You will note, because of immediate practical considerations, I have omitted to mention the proposed transmission via satellites or the moon. These communication arrangements have almost eliminated distance as an element in data processing and have expanded enormously. Their importance is readily appreciated for a company engaged in railway operations; perhaps not so readily appreciated is the rapidly increasing use of electronic transmission by many other businesses. I read the other day that the *American Telephone and Telegraph Company* expects data communication between machines in different cities to exceed voice communication over telephone lines by 1970. As one commentator remarked: "The consequences of such a change are staggering, not only for the telephone system but for the procedures by which the remainder of US business is conducted."

I have referred to a period of 2,800 years of manual processing; 40 years of traditional mechanisation, and 10 years of electronics. Market researchers predict a doubling of electronic devices in the next five years. It is certain everyone is going to have to run hard to keep abreast of developments.

Canadian Pacific Background

To continue building up background, it may be useful if I tell you a little about the *Canadian Pacific* program for processing freight data. Early in 1955, when full-scale planning began, *Canadian Pacific* adopted the "one shot" or "comprehensive" approach to processing of freight information within a general overall company-wide integrated plan to serve all departments. The method is to record information in mechanical form at source, or as close to source as is practical in terms of cost, time and techniques. Once recorded in mechanical form, data are processed entirely by mechanical means. New information pertinent to that already recorded is itself recorded in mechanical form as succeeding events occur, and is integrated with the existing record. The output—processed information—is designed to meet the final requirements of all users. "Final requirements" means that the recipients should be able to use the output with a minimum of further processing on their part.

The nature of our business dictated the physical set up. Machine equipment is installed at 68 of our principal yard offices from coast to coast, with teletype transmission between adjacent yard offices and to one of the four regional data centres established at Montreal, Toronto, Winnipeg and Vancouver. The mechanised yard offices serve as recording points for data originating in their locality and as receiving and distributing points for data received by wire from adjacent yard offices or in feedback from the data centres.

Three of the four regional data centres are equipped with fairly extensive conventional machine installations. They transmit information from field offices to our main computer centre in Montreal, do some processing for regional purposes, distribute processed information received in feedback from the computer centre to regional offices, prepare the first mechanical recording of source information for some of our IDP applications, and do mechanical processing for *Canadian Pacific* subsidiaries. Thus, Pacific Region Data Centre, Vancouver, serves *Canadian Pacific Air Lines*; Prairie Region Data Centre, in Winnipeg, serves *Canadian Pacific Transport*, while Eastern Region Data Centre, in Toronto, handles *Canadian Pacific Express*. Processing and other machine functions for the fourth regional Data Centre, Atlantic Region in Montreal, are handled as part of the Computer Centre in Windsor Station.

This Computer Centre has the most comprehensive complex of data processing equipment in Canada and, so far as is known, the largest in transportation service anywhere in the world.

The manner in which this physical equipment is used to provide a completely integrated system can be illustrated by following the data abstracted from the waybill—the principal source document covering our freight business. Waybill information required for all purposes is recorded in the field office, transmitted to the Data Centre and relayed thence to the Computer Centre where it is maintained on magnetic tape. At the field office, a paper tape containing only those portions of waybill information required for movement purposes is produced as a by-product of the original recording and filed for subsequent use. When trains are assembled, information covering the locomotive, crew, tonnage, etc., is punched in a tape and pieces of tape for each car are selected from those previously filed. These are used to produce a new continuous tape from which to print out a train consist, in the order in which the train is marshalled, for the conductor. The tape with train consist information is then transmitted to the Data Centre and simultaneously to the next yard office where it is used to plan switching operations. At the Data Centre, it is used to give train and car movement information to regional offices. It is also relayed to the Computer Centre where it is matched up in the computer with data received previously. This process is repeated each time the car moves and when any new event affecting it occurs, such as diversions, trans-shipments, etc. Once each day, all this data is processed so that magnetic tapes are available before the opening of business which contain a continuously updated record of the physical status of all cars as of a cut-off a little after midnight. This record, which, of course, was never before possible, is the foundation from which other processing produces outputs to meet all requirements of all departments.

Up-to-date data on the cars in which they are interested fans out daily to operating and traffic officers all over the continent to help them improve our service to the public. Each day we receive about one hundred thousand records pertaining to the one hundred and five thousands units of equip-

ment we have to keep track of on our rails and, in the case of our own equipment, on rails of other carriers all over the continent. These records are taped, transmitted, processed, analysed and assembled in reports for operating, transportation, traffic and accounting purposes at various levels and for government reports.

In contrast, the old method was for each department to extract data to serve its own needs. A great deal of duplicate manual processing of information took place and progressive summaries were transmitted from one departmental level to another. Under IDP, the main data transmission and summarising is done in a unified or integrated flow stemming from the original mechanical recording.

This, of course, completely alters the basis and timeliness of management control information. The old basis resulted in the transmission of a limited amount of information through a number of departmental funnels, up from below. By the time the diversified and often unreconcilable information was brought together manually at the top, it could be the subject of many arguments. The new basis provides for a single integrated flow, with the output appropriate to each level and particular purpose coming mechanically from a common source, so that the basic facts behind the information furnished all departments can be the same and, often, much more comprehensive.

In terms of the new concepts, the Canadian Pacific program is now at a very interesting stage. We have developed a working integration of transportation data collection and processing over a very broad field. From the freight information now available to us on magnetic tape, we believe that we should be able to provide the most sophisticated control information management can ask for. We have already brought some new controls into operation and others are in development. We have gone just far enough to realise how much more can be done as specifications are agreed upon.

While I have described in some detail our integrated freight operations project, we have made important progress in other fields also. Payroll processing for all our employees has been consolidated in Montreal. Our dividends and shareholder records are also being handled by the computer. We have a very interesting application whereby the multitude of journal entries which are originated to produce our general accounting records are processed mechanically to produce the General Ledger and its many subsidiary ledgers. Because of the extent of our *Canadian Pacific* complex and the variety of applications possible, I do not anticipate that in the foreseeable future we shall run out of projects to reduce manual data processing effort further and to improve the nature of business intelligence made available for management purposes.

In the context of the background described, let us consider in turn the four accounting functions under which I suggested these remarks would be organised.

Impact on the General Accounting and Control Function

The first was the general accounting and control function. It has been said that EDP has not changed any of the fundamentals of accounting. These remain the same. The change is a physical one affecting the manner in which accounting tasks are performed. The mammoth clerical operation involved in collecting, summarising, accumulating and posting individual records to bring them together into useable form is now done mechanically.

In our own case, for example, mechanisation begins with recording the revenue information from the waybill at or near source, carries through to a computer match with final settlements at destination, and proceeds through successive stages until the transaction is reflected in a mechanically produced General Ledger of the Company. In the process we have more comprehensive controls than previously.

The old clerical operation represented a major portion of the effort of any accounting group. Company accounting personnel were, in a sense, largely data processors. With this chore largely removed, in future their prime accounting function will be that of control and analysis. Analysis can, in turn, be greatly facilitated by EDP. The computer makes possible much more informative analyses of results—analyses which would be prohibitively expensive in terms of staff time if produced clerically—and, what is more important, makes it possible to deliver them in time to be of use in current, as well as long range, planning of the operation of the business. I shall have more to say about this presently.

Impact on the Internal Audit Function

This brings us to the second function—internal audit. Although the purpose of audit is not changed, the manner of its achievement is also drastically changed by EDP. The main problem is the creation of an audit trail when confronted with the invisibility of records.

No matter what methods of record keeping are employed, internal auditing in any organisation presumably will continue to revolve around two principles:—

(*a*) the establishment and maintenance of built-in controls within the system.
(*b*) the checking of records after entry to ensure accuracy.

In the past, under manual procedures, internal audit saw to it that the traditional concept of divisions of responsibility was carried out—ensuring that no single individual was involved in the control of recording a transaction right through. One authority would originate charges against the company's debtors, a second would record them and prepare the bills and a third would receive and record the settlements. This type of organisation makes collusion necessary before a fraud can be perpetrated, and the internal auditors did sufficient checking to see that this was not likely to occur.

Establishing controls in EDP is somewhat different. A characteristic of EDP is that far fewer people handle a record—in fact, EDP planners are striving to have the fewest possible people handle records. This makes necessary more emphasis on ensuring that records at the point of entry into the machine processing procedures are accurate, authentic and complete, and that the machine processing itself is sound in all respects.

Two new responsibilities for the internal auditor which, incidentally, he shares with the external auditor, are:—

First—to learn and apply what the new machines can do for him in the way of providing, mechanically, not merely the audit controls which he formerly developed manually, but completely new tools for audit work. He should be interested in the possibility the computer offers for 100% audits that can be built into procedures as a by-product, and for entirely new audit criteria.

Second—to ensure that audit requirements in the form of printouts, and opportunities to match them with selected original documents are incorporated in the new procedures.

He will find, too, that he has to move a little faster. Magnetic tapes, with all the details, are not preserved indefinitely. His checks and audits must be made when they are still available, and his requirements must not involve unduly long retention or excessive machine processing time.

From what I have said you will readily appreciate that each application will require its own special brand of controls. May I add that our experience to date would seem to indicate that EDP simplifies the internal audit function rather than the reverse.

Impact on the Professional External Audit Function

As just mentioned, the problems of the third function, professional external audit, are closely aligned with those of internal audit in ensuring that adequate internal controls exist and have the desired effect, and in ensuring that sufficient records are produced at various stages in processing to allow subsequent tracing through of transactions.

To enable the external auditor to express an opinion on the financial statements, he must satisfy himself as to the accuracy of the accounting records, that no fraud has been committed and that generally accepted accounting principles have been followed. It would be presumptious on my part to outline how this function should be performed. I have read with interest a pamphlet issued by *Price Waterhouse and Co.* entitled "The Auditor Encounters Electronic Data Processing." There are many other thoughtful essays on the same subject. From their tenor I would judge that in the professional auditors' opinion, external audit can be appropriately adjusted to the new conditions.

Perhaps I may be permitted to say that I suspect that, apart from the management consultant portion of accounting firms, far too few of the professional accountants have yet become sufficiently immersed in the new EDP developments. This is a pity because, through the experience they gain as they move from one firm to another with different approaches, they could play an important role in helping clients include the safeguards which undoubtedly are required before the new systems can be accepted as satisfactory.

Impact on the General Business Intelligence Function

The fourth function is general business intelligence. This is the one to which I wish to give prime emphasis in this paper. Much of this business intelligence must originate in the Accounting Department. It is here that EDP can have its most profound impact by providing better management information than would otherwise be possible. Better information must be followed by a rapid change in the organisation and methods of management control. This will in time change the fundamental character of management itself.

Better management information stems from the ability of the integrated system to fulfil five essential requirements. These are:—

1. To provide pertinent basic information in a useful form to each department at various levels of operation, and meet the ever-growing demands for statistical and corporate information required by government and regulatory authorities.
2. To provide storage for new and old information on the widest possible range of company activities.
3. To provide thoroughly reliable information.
4. To provide the information at the earliest useful time.
5. To provide selected information which will require a minimum of further human manipulation to achieve maximum objectives.

I have already illustrated the first of these, providing basic information in a useful form, by reference to our method of handling waybill information and the distribution of output.

The second, storage of information, is achieved through the use of magnetic tape which provides a large reservoir of recapturable information upon which to draw. At present we can store on one reel of tape the equivalent of four books the size of the Bible. Such a reel can be read into our computer in a matter of four minutes.

The third requirement is the ability to provide thoroughly reliable information. When data was being assembled manually, piece by piece, errors occurred which in many cases passed detection. With integration, if, for instance, proper sequential reports are not received on a freight car, this shows up immediately. While the dangers of error through the capacity of the computer to multiply errors are greater, there is more opportunity to build in safeguards as the data from one source or one report is compared with that from another. As these techniques are refined, our experience shows that the reliability of data will far exceed anything heretofore available.

The fourth requirement, the ability to provide information at the earliest useful time, is one of the most important changes that has taken place. In the past, there was a great deal of information management wanted which could not be economically compiled in time to be of use. This has been changed by the new hardware. The assembly of one hundred thousand freight transaction records received daily, updating of one hundred and five thousand master records for cars on and off line, and selection of data for reports to be available on officers' desks when they come in each morning, now takes only five hours of computer time. It soon will take less. Under old methods it just could not have been done. Statistics used to be a matter of history. Now they can be news. We used to produce gross ton miles per train hour, a useful indicator of operating performance, three weeks after the end of the month. Now we can provide yesterday's figures at the opening of business today as a by-product of other processing. Other information can be produced to plan present action, rather than to measure past performance.

The fifth is the production of selected information that will require a minimum of further human manipulation to achieve maximum objectives. The problem here is to use the capacity of the computer to select useful data requiring attention instead of printing out voluminous reports demanding extensive human work to ferret out such data. A readily understandable example of this is the production of a statement of inventory items in over or short supply instead of a complete listing of all inventory items.

In using the new tools to provide better management information, we can also make more extensive use of techniques of statistical analysis and cost analysis which have been known for years. Some of these can be done, with considerable labour, without the aid of a computer. Comprehensive, accurate and timely information now available, joined with the capacity of the large computer, make it

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possible to use such techniques in areas not heretofore practical. For example, evidence on the cost of handling grain, presented to the MacPherson Royal Commission on Transportation, was based on the most intensive analysis of railway costs that has ever been made. These studies were made on the computer using multiple regression analyses. They were concrete evidence to our management of the value of the new tool.

The computer can also be used to simulate physical operations as an aid in the solution of business problems. One technique involves building mathematical models using various assumptions to determine those which would give the most favourable result. We have used this successfully in simulation of train performance, using data for different types of motive power as a basis for setting tonnage ratings and determining schedules which would give the best relationship between speed and fuel consumption; also in the design of hump yards and centralised traffic control layouts. There a long list of potential uses.

Recently I had the privilege of attending the 12th International Conference of an organisation called "Guide." These were not "Girl Guides," but the highly intelligent top EDP representatives of some 300 organisations having large-scale IBM digital computers. I have followed the physical and mental growth of this organisation over the last five years. This year again one could judge from the sophisticated papers presented that the horizons are still widening and useful accomplishments are increasing. In a large company, there are only a few people who combine experience in systems analysis with knowledge of a segment of the company's procedures. In the present state of the art, there are few systems analysts who have a wide knowledge of all the new techniques. The art has moved so fast that those working in it have as many specialties as there are different specialties among the medical doctors.

There are therefore two tasks ahead. The first—for a small core of specialists and general practitioners—to try to keep abreast of the best technical and systems developments in this rapidly maturing field. The second—for a wider group to endeavour to take advantage of and incorporate these new techniques in day by day operations as rapidly as possible. These are not easy tasks. The first requires hard-working men of wide vision, quick absorption, initiative, judgment, perseverance and many other attributes. The second requires similar aptitudes. By the nature of things, for their main duties, other aptitudes are also essential and it is probable that the ultimate goal will not be effectively accomplished until a completely new generation of managerial and supervisory personnel has grown up with EDP.

There are some who think the small group of specialists and general practitioners, as I have called them, can themselves plan for and provide the better business intelligence which is required. They can help, but I am convinced that it is much easier to teach a wide group of people the new techniques than it is for any small group to acquire the diverse knowledge and experience of company operations necessary to fully exploit for management the type of use of data processing facilities which will be routine ten years from now. When such a wide group know what can be done they will be able to recognise many places where innovations could be profitably adopted. It is, of course, a joint effort of both groups, but all my discussions with others in this field indicate the danger of leaving the initiative to the systems analysis personnel. This might be tolerable were only systems at stake, but the present revolution goes much further and will only mature when management itself takes the lead in specifying the new types of information it can advantageously use from the almost unlimited reservoirs of timely data now available.

I have probably said enough to make the point—we are dealing with an entirely new basis for the development and provision of management control information. Over the years this control information has followed well-defined lines due to time and cost factors inherent in the old systems. It will take a great deal of trial and error work by a lot of people to devise the new pattern which must emerge because of the change in time and cost factors that has taken place.

The Role of the Accountant

The modern integrated data stream involves the initiation, transmission, processing, compilation, retrieval and effective use of control information. The accountant has his traditional role to play in seeing that the data in this stream and the way in which it is handled fully meets accounting requirements.

There is, however, the still broader role which I have already dealt with at length. The accounting function gives company accountants a good overall picture of the flow of information through a company, of all the various requirements of management, of corporate responsibility to provide information to shareholders, and of statutory requirements. Through experience of manual accounting, they know the prime sources of many of the multitude of entries which go to make up a company's records. Better than any other group within the company, their training and experience qualify them for a leading role in the planning and development of an integrated system of data processing.

As you will notice, for the reasons previously outlined, I was very careful to say *a* leading role, not *the* leading role. The development of an integrated system requires experience and skills drawn from all departments, and an appreciation on the part of all who work on it that their responsibility is company-wide, not departmental.

This will demand a high degree of preparation. Accountants, more than other departmental users, must study the tools—the capacities of the machines, what they can do and what they can not do. It is not just a matter of memorising the speeds at which a given computer can perform additions and subtractions or make logical decisions. It means learning how the computer works, acquiring a sound general grasp of how the many streams of data that constitute input are processed through to produce the almost infinite variety of outputs.

To learn the tools is one thing. To bring creative and imaginative thinking to their use is something else again. Here, beyond doubt, is the greatest opportunity and the greatest challenge. It is not easy to discard traditional approaches and traditional uses. For some of us, at least, it is not easy to overcome our fear of the unknown and we are prone to fall back on the old ways or, equally futile, to be satisfied with the old results. Reading, attendance at seminars, discussion with others, will all be required to broaden one's experience and confidence.

At the other extreme, one could be over enthusiastic. There is a temptation to use the computer to do things that need not be done, just because the doing of them is possible—to demand *complete* information when selected information, or more sophisticated combinations, would suit the purpose better.

For the accountant, the blueprint is clear. He is going

to have to master the new technology, to know more and more about more and more things, and to distil those elements of business intelligence that will best contribute to efficient operation. He must share in building the new system to provide them.

This will demand hard work—the ability to throw off the not unnatural conservatism of many accountants. It will require patience, since the road is a long, difficult one. The careful planning required must be measured in years, not months, and results will seem slow in coming. It requires courage. Computer rentals and computer costs are high, yet they are only one element—indeed, the costs and systems design effort associated with data collection and data transmission are often substantially more costly than the computer itself. Above all, it will require vision—the vision to design an overall system and fit the pieces in one by one to provide for the total corporate requirements of the firm.

An efficiency expert has been described as one who walks in his sleep so that he gets his exercise and his rest at the same time. Our human brains are going to have to find some equivalent means of doubling up, if they are to succeed in keeping up with the ingenuous ways in which the power of the new technology and mechanical brains can be used to enlarge man's capabilities.

DEUCE USERS' COLLOQUIUM ON DATA HANDLING

The eighth DEUCE Users' Colloquium, on "Data Handling," was held on 21 April 1961; it was one of the first large meetings in the new Glazebrook Hall at the National Physical Laboratory, where it was held by kind invitation of the Director.

Apart from the fine facilities of the hall, the Colloquium benefited from the practised N.P.L. way of handling large meetings and from a number of demonstrations of data-handling operations at N.P.L. which were arranged during the lunch break.

The Colloquium papers described a remarkable collection of peripheral devices which have been connected to various DEUCES and used to collect data and display results. There were also survey and discussion papers on related topics. Although the papers contained a good deal of solid material, the discussion was rather less lively than on previous occasions.

Attendance was by far the largest yet, about 150 people coming from outside and many more from N.P.L. The chair was taken by W. E. Scott, Manager of English Electric Data Processing and Control Systems Division.

The first session dealt in general terms with methods for collecting and transmitting data.

T. Vickers of N.P.L. considered the particular requirements to be met in collecting data from various classes of physical experiment; he also listed some of the binary codes used to represent data and discussed factors which might affect the choice of code for a particular application. A. Anderson of N.P.L. and W. H. P. Leslie of the National Engineering Laboratory, East Kilbride described particular applications and data collection equipment at their establishments; Mr. Leslie also raised some controversy on the subject of data smoothing.

T. B. Boss of N.P.L. presented a survey of currently available equipment for the preparation of paper tape, particularly in business applications. S. Skoumal of Marconi Wireless Telegraph Company gave a very thorough survey of data-transmission techniques and systems.

The second session was based on more than twenty brief notes on particular applications; only a selection of these could be presented at the Colloquium, but all were open for discussion.

Applications included the retrieval of information from a library, the real-time analysis of general election results, checking of payroll data, control of work movement on a shop floor, weapon trajectory computation from range-trial data, the analysis of data from wind tunnels, water tunnels, ship-testing tanks, seagoing ship trials and interferometer readings, and triangulation of aerial photographic surveys.

Equipment described included a number of special-purpose data recorders and an on-line teleprinter which had been fitted to the DEUCE at Liverpool University; Liverpool also described a programmed time-sharing system by which an independent program could be run in the intervals between rows on a low-speed paper-tape punch.

The third session was a discussion of some punched-tape character codes currently under consideration as standards.

In the final session, a number of devices were described which were used to provide graphical outputs from DEUCE. These included the direct use of cards from the computer laid out on a standard board, a modification to a standard punched-card tabulator to enable it to print graphs, and curve-plotters which had been fitted to the A.C.E. at N.P.L. and to a DEUCE at English Electric, Kidsgrove. The most impressive demonstration was a fine set of perspective drawings which had been produced on a curve plotter at English Electric, Whetstone, from cards punched by their DEUCE.

The general discussion on the Colloquium was opened by E. C. Clear Hill of De Havilland Aircraft Company, who surveyed the range of applications and equipment which had been discussed, and suggested possible future lines of development.

SYMPOSIUM ON MODERN COMPUTING METHODS

Reported by A. R. Curtis

To mark the publication of the new and completely revised edition of the book *Modern Computing Methods* (NPL Notes on Applied Science No. 16) a symposium was held at the National Physical Laboratory on Wednesday, 14 June. The invited audience of over two hundred people consisted mainly of lecturing staff from Technical Colleges, staff of University Computing Laboratories and representatives of other major computing centres.

The objective was to discuss the use of the book for courses in numerical analysis at Technical Colleges and Universities. The proceedings comprised four sessions, the first part of each consisting of short lectures in which the various authors gave reasons for their particular choice of material and outlined the relative importance of each topic in practical applications. Each session concluded with a period for questions and discussion.

The chair was taken by Dr. E. T. Goodwin, Superintendent of Mathematics Division, NPL, who extended a brief word of welcome to those present and stressed that the needs of those teaching numerical analysis should be borne in mind during the discussion.

Linear Algebra. (*Chapters 1, 2, 3, 5*)

The preparation of these chapters and the philosophy behind them were described by Mr. J. H. Wilkinson. He said that contrary to earlier beliefs, the Gaussian elimination process for the solution of simultaneous equations is highly stable provided "interchanges" are used. Compact methods of elimination have the advantage of reducing the associated matrix to triangular form directly, thus avoiding most of the writing down and decreasing the effect of rounding errors. On those high speed computers for which the product register is unable to accumulate inner products to double-length accuracy, full advantage cannot be taken of the accuracy offered by the methods based on matrix resolution.

When solutions with several right-hand sides are needed, much of the arithmetic involved in matrix resolution does not have to be repeated, and it is only when there is a large number of right-hand sides that inversion becomes worth while. Similarly, the iterative process for improving accuracy is particularly efficient with several right-hand sides, but if the matrix of the left-hand side is very badly conditioned recourse to double-length working is desirable.

Deflation methods of finding the latent roots of matrices also oddly have a reputation for instability; the methods given in chapter four are in fact extremely stable. Details of Householder's method for symmetric matrices were omitted with regret, and a whole volume would have been needed adequately to discuss direct methods for unsymmetric matrices. The presentation of the chapter on Error Analysis had deliberately been kept as simple as possible.

In reply to questions Mr. Wilkinson said that of the various possibilities for specifying the diagonal elements of the triangular matrices occurring in matrix resolution, there were certain computational advantages in the symmetric case in taking $|u_{ii}|=|l_{ii}|$. He later commented on the non-random nature of rounding errors occurring in matrix processes; this should be borne in mind when consulting the classical statistical analysis of the effects of rounding errors due to Goldstine and von Neumann. On being asked whether error analyses existed for the variations of Gaussian elimination he replied that they did, but that the results are not quite so powerful.

Lastly he was pressed into discussing the merits of interchanging columns during Gaussian elimination. He replied that partial pivoting, as it was often known, achieves less than total pivoting; but that in practice one would need to solve many thousands of sets of equations before meeting a case where the gain would be significant. On a high speed computer with a single level store (as opposed to two-level store machines) so little extra programming would be needed to incorporate total pivoting that one would probably do it automatically.

Iterative Methods. (*Chapter 4*)

The situations in which one would have recourse to iterative methods for solving simultaneous linear equations were described by Dr. D. W. Martin. Such methods come into their own for very large sets of equations, particularly, as is often the case, when many of the coefficients are zero. The method of presentation used in the book is to illustrate fundamental principles by discussing examples of the very simplest methods; this accounts for the inclusion of the Jacobi and Gauss-Seidel methods which one would not use in practice. Successive over-relaxation, however, is used in practice and is described in this chapter. For the deeper theory of this and more complicated processes, the reader is referred to the bibliography.

Zeros of Polynomials. (*Chapter 6*)

Dr. F. W. J. Olver explained why this chapter has been completely rewritten in the light of experience gained on automatic computers. Finding the roots of polynomials is a problem of relatively rare occurrence compared with ones in linear algebra or differential equations (although of course it can be a by-product of either).

An elementary course on the subject should include: (*a*) nested multiplication, (*b*) successive linear interpolation, and (*c*) Newton's rule. The more advanced course should include Bairstow's process and instruction about the phenomenon of ill-conditioning, but exclude root-squaring.

Asked to comment on the choice of initial guesses to quadratic factors when solving polynomial equations by iterative processes, he said that Wilkinson's device of taking the last factor found as a first guess to the next is effective since, if the roots are close together we have a good guess when we need it, while if they are well separated it is not so necessary that the guess should be a close one. For the first

quadratic factor on an automatic computer any simple first guess would do, z^2 for example. But when setting an examination paper, an approximation to the first quadratic factor should be given to the candidate.

J. H. Wilkinson pointed out that to make a Bairstow programme work, however, a few gimmicks are necessary. For example, with Newton's process (which is easier to talk about than Bairstow) if zero were taken as a first guess to a root, the next iterate, even with some very well-conditioned polynomials, can be very large and subsequent iterates would wander back very slowly to the neighbourhood of the roots. Consequently large changes in an iterate must be artificially inhibited.

The chairman then remarked that convergence in the large is usually quite good. The complex plane is not like a golf course with a requirement that the first guess is on the green, but has extensive conical depressions within which there is satisfactory convergence.

Finite Differences. (*Chapter 7*)

Dr. Olver briefly introduced this chapter by pointing out that it is a description of the classical theory; the subject no longer dominates numerical analysis, but nevertheless all students should be familiar with it, as it is a basic grounding to numerical analysis and fundamental to the study of other topics, particularly ordinary and partial differential equations. He made a special plea for adherence to the notation of the chapter which is now standard.

Chebyshev Series. (*Chapter 8*)

This chapter was introduced by Mr. C. W. Clenshaw. He first stressed the fundamental nature of the problem dealt with here, that of representing a continuous function by a small set of numbers. For this purpose series of polynomials are often more convenient than the theoretically more efficient rational fractions because of the ease with which they may be added, differentiated or integrated. On a high-speed computer polynomial approximations designed to cover a long range have much to commend them. There are considerable advantages in using the coefficients of the Chebyshev expansion rather than those of the rearranged polynomial; the former are independent of the degree being used, and the latter are often inconveniently large in magnitude. Mr. Clenshaw concluded by paying tribute to the pioneer work of Lanczos in this field.

In the ensuing discussion he suggested that in practice the coefficients in a Chebyshev series are usually computed from the summation formula rather than from the integration formula. If the initial estimation of n, the number of terms needed, is sufficiently high, the summation formula is adequately accurate, and it is invariably simpler to use. One should normally choose n so that c_n and one or two preceding c's are negligible.

Another question raised the difficulty of representing in Chebyshev series a function with, for example, an infinite derivative at the end of the range. Mr. Clenshaw pointed out that any function that can be tabulated in orthodox fashion can be expanded in Chebyshev polynomials using a reasonable number of terms; features such as infinite derivatives which may cause difficulties in one form will cause them in the other and it is then often advantageous to transform one or both of the variables.

Ordinary Differential Equations. (*Chapters 9, 10*)

Dr. E. T. Goodwin first remarked that to the mathematical analyst the linearity or non-linearity of a differential equation is probably the crucial distinction, but a numerical analyst is usually more concerned as to whether the supplementary conditions are given at a single point or at more than one point; hence the division between Chapters 9 and 10. It is unreasonable, he asserted, to look for a best method in general, or even for one that is satisfactory in all contexts.

The teacher would do well to follow the example of Chapter 9 and start with the Taylor-series method; not tnat it is used extensively in practice, but it is the best link with the student's classical mathematics. The finite-difference methods, however, are quite hard to assimilate, and often not suitable for automatic computers. The Runge-Kutta type formula given is one of the simplest; others are to be found in the literature.

Non-linear equations may result in linear or non-linear finite-difference equations; the non-linear ones are not necessarily to be avoided, as a very good approximation to their solution is always available by extrapolation of the results at the previous integration steps.

The causes and types of instability are illustrated by very simple examples.

In Chapter 10 direct methods for solving boundary-value problems are emphasised. For linear finite-difference approximations the methods of previous chapters can be applied to the band matrices involved.

In answer to a questioner who wanted to know whether Runge-Kutta formulae other than fourth order were used in practice, it was stated that use was often made of second-order formulae, and that in any case such formulae should be used for teaching purposes. On being further asked what other methods (besides Runge-Kutta) were suitable for automatic computers, Dr. Goodwin replied that predictor-corrector methods were used quite extensively, and that for special purposes most of the deferred-correction methods have been used, particularly where Runge-Kutta is unsuitable owing to the presence of very rapidly decaying-type functions in the solution.

Hyperbolic Partial Differential Equations. (*Chapter 11*)

Mr. J. H. Wilkinson drew attention to the theoretical nature of this chapter which largely deals with the classification of partial differential equations. The second-order quasi-linear equation is dealt with in detail; considerations of space prevented the inclusion of the simpler and more illustrative theory for the first-order equation. This theory he then described. He concluded by remarking that in the hyperbolic case the nature of the solution is far more intimately tied up with the physics than in the other cases. Later he enquired whether any universities and technical colleges apart from Imperial College now commence their courses on partial differential equations by outlining the classification into elliptic, parabolic and hyperbolic types. It transpired that several, though obviously not all, did.

Elliptic and Parabolic Equations. (Chapter 12)

Concluding the treatment of partial differential equations Dr. E. T. Goodwin urged that from the teaching point of view parabolic equations form the most suitable starting point, as they are much more like systems of ordinary equations. In this chapter the nature of the stability of the various methods is given fairly detailed consideration.

The treatment of elliptic equations is extremely brief, but the subject is far too vast to give any detail, and it is not likely that many other than extremely specialised courses would be able to give much either. The iterative methods of Chapter 4 are very relevant to the solution of the systems of finite-difference equations involved.

Several speakers from the floor suggested that engineers and physicists would be more interested initially in elliptic rather than parabolic equations, particularly at establishments that did not have ready access to an automatic computer; they would then in such circumstances have recourse to relaxation methods. Dr. Goodwin intervened to deplore the over-emphasis placed on relaxation methods in some courses.

There followed a rather general discussion in which it was asserted that engineering students ought to be educated from the start to use numerical methods, but that their courses should include the easy and not the sophisticated processes; that only in the third or post-graduate year should they tackle numerically a full-scale technical problem; that the student should be warned against assuming that the successful solution of examples of Laplace's and Poisson's equations ensured success for all elliptic equations; that matrix methods should be taught much earlier; that it was not helpful to assume that all teaching establishments had access to an automatic computer, and lastly that at some universities it was policy for all science students to be given very early experience on an electronic computer.

Evaluation of Limits and Integrals. (Chapters 13, 14)

He had taken care when writing the opening section on the deferred approach to the limit, said Mr. G. F. Miller, not to stress the special case of h^2-extrapolation. A rather disjointed variety of topics were included, but they were all of general application. Aitken's method is a device that one should always be ready to use particularly in linear algebra. The variant of the Euler transformation due to van Wijngaarden is particularly well suited to automatic computation, and provided the extra figures are available van Wijngaarden's own transformation for series of positive terms is likewise suitable.

Chapter 14 covers mainly methods of integration suitable for automatic computation. Only basic ideas for the calculation of singular integrals are presented. Numerical methods in this field may sometimes be more efficient than formal integration even when this is easily performed; on the other hand a little mathematics may in other contexts save a lot of labour and machine time.

Following an enquiry about actual experience of van Wijngaarden's transformation, those who had used it pointed out that it often gives answers that cannot be easily obtained otherwise, and that it is applicable in situations where the Euler-Maclaurin formula is not.

Tabulation of Mathematical Functions. (Chapter 15)

Dr. F. W. J. Olver pointed out that little of the material of this chapter is readily available elsewhere. It should be regarded mostly as background reading for the student.

The concept of numerically satisfactory solutions of a differential equation is a most important one. Subtabulation has been omitted as it is less important now than in the desk-machine era and is well covered in the booklet published by the Nautical Almanac Office. The use of auxiliary variables both for the argument and the function should be familiar to the advanced student. The concept of modulus and phase is more than just an example of auxiliary variables as these functions often have a physical meaning of their own.

Finally, future tables, especially of two or more variables, are more likely to be produced in machine form than in the orthodox form.

Replying to questions Dr. Olver agreed that students need not know how to make tables, but that they should know what tables are available and be able to use and recognise a good or a bad table. On a further point he said that it had not been found necessary to use subtabulation on automatic computers; subsequent discussion elucidated that it would only be used for rather specialised processes on a small machine. Although another speaker felt that subtabulation had not been used because few functions that really took a long time to calculate on an electronic machine had as yet been computed, Mr. C. W. Clenshaw felt that in those circumstances he would unhesitatingly prefer to compute the appropriate Chebyshev coefficients.

Bibliography

Dr. Olver concluded the treatment of the book by explaining that the purpose of the bibliography is to suggest further reading to the student, and to provide references for more detailed work. One or two subjects not covered in the main text such as curve-fitting and integral equations are included in the bibliography, as are tables of elementary functions and descriptions of computing machines. Guiding comments have been appended to nearly all of the references.

General Discussion

This was opened by Dr. L. Fox who first commented that many changes, all for the better, had been made when preparing this edition. What, he asked, would happen if we used this book as a textbook for a University course? A novice would need guidance on some of the basic facts of numerical calculus, on topics such as absolute and relative error, cancellation of leading digits, and the error in a function caused by using a rounded argument.

The first six chapters would need very little addition to make the basis of a good university course; perhaps the matrix equivalent of Gausian elimination should be included. Mathematical students would want to know something about matrix norms.

The rest of the book is too terse for a student without his supervisor providing a lot of extra material, but this terseness is inevitable from considerations of space. However, something on remainder terms in finite-difference formulae would have been welcome, as also would a section on divided differences and the Aitken interpolation process.

Chapters 9 and 10 form a useful introduction to ordinary

differential equations, particularly as stability is mentioned, but the supervisor would have to provide much additional material and guidance on boundary-value problems. This last remark applies to elliptic partials also. The comments in the bibliography are well worth while.

Lastly, he affirmed, that for the teacher of numerical analysis, mathematics should always come first.

When asked what kind of mathematics he had in mind when making his last remark, Dr. Fox said that engineers and physicists must understand the mathematics of their own problem, and also be taught enough to enable them to read and comprehend this book. He added that in some quarters it was thought that computers are necessary for teaching computing and mathematics. He disagreed strongly and felt that only too often machines are acquired to provide an excuse for not teaching mathematics.

In reply to another question Mr. Wilkinson admitted that the description of triangular decomposition given in Chapter 2 is rather heavy going, and suggested that it might be possible to describe it more clearly in ALGOL.

Upon it being suggested that the example given of an ill-conditioned polynomial was rather an unfair one and possibly misleading because of the reality of all its roots, it was stated that ill-conditioning was a very common phenomenon for polynomials even of moderate degree, whether their roots were real or not. Our first experience of really severe ill-conditioning arose in an equation arising in a physical problem and submitted to us for solution. Theoretical estimates of the likelihood of all the roots being real are not met in practice, as in the special but common case of the characteristic equation of a real symmetric matrix the roots are all real.

Another speaker suggested that since engineers and mathematicians have different aims, they needed different courses in numerical analysis. He also warned of the danger of assuming that the use of Simpson's rule at two different intervals gave a sufficient check. The Chairman intervened to draw attention to a paper by Clenshaw and Curtis, referred to in the bibliography, which discusses the danger of using such a check both with Simpson and with Gauss.

The attention of the meeting was then drawn to the efforts of the British Computer Society which is examining the content of suitable training courses for those about to enter the computer field. One of their biggest problems is the assessment of the mathematical content of such courses. The minimum equipment and hardware for establishments giving such courses was then discussed. At schools the desk machine was sufficient; at technical colleges and universities equipment for the preparation of computer data and access to somebody else's machine is a realistic minimum. A plea was also made for a compendium of examples arising from live problems.

Other points mentioned in the concluding moments of the discussion were the pitfalls of rule of thumb application of a method or use of a program; the necessity of giving engineering students faith in numerical methods before warning them of the many pitfalls; regret for the omission from the book of the section on how a computer works; the attitude of some firms who regard the acquisition of an automatic computer as a reason for withdrawing their staff from courses on numerical analysis; and a brief mention of some of the unsolved problems of numerical analysis.

The proceedings were brought to a close by the chairman who thanked the audience for their attendance and attention, pointed out the value of sharing experience in the subject, and invited further contact with NPL.

Note. The attention of readers is directed to Dr. M. V. Wilkes's review of 'Modern Computing Methods' on p. 75

Imperial College of Science and Technology

Colloquia on Numerical Analysis and Machine Computation to be held in Room 342, New Mechanical Engineering Block of Imperial College, Exhibition Road, London, S.W.7, at 2.30 p.m.

11 October. Mr. M. Woodger (*Mathematics Division, NPL*):
ALGOL.

8 November. Dr. S. Vajda (*Admiralty Research Laboratory*):
Mathematical Planning Methods.

13 December. Dr. I. M. Mills (*Reading University*):
Calculation of the Force Constants of Molecular Vibrations.

14 February. Dr. J. Corner (*AWRE, Aldermaston*):
Digital Computers for Research and Development in Atomic Energy.

Details of further meetings can be obtained by writing to Central Distribution Office, Imperial College, 178 Queen's Gate, London, S.W.7.

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Southampton Branch

A programme of meetings has been arranged for the coming winter. These meetings will be held on the first Monday of each month at Southampton University with two exceptions. The programme is as follows:

2 October. Mr. A. Cushion (*Central Register Office*):
Processing Methods used for the 1961 Census.

6 November. Speaker to be finally agreed:
Character Recognition for Bank Automation.

4 December (in Bournemouth). Mr. I. C. Pull (*UKAEA*):
Monte Carlo Methods with particular reference to Neutronic Calculations.

8 January. Mr. G. E. Deadman (*Ferranti Ltd.*):
An Airline Sea Reservation System.

5 February. Dr. S. Vajda (*Admiralty Research Laboratory*):
An Introduction to Linear Programming.

5 March (in Bournemouth). Mr. J. M. Bowen (*Bournemouth Borough Treasurer*):
The use of Computers in Local Government.

2 April. Mr. M. Woodger (*National Physical Laboratory*):
Some Aspects of ALGOL.

7 May. Annual General Meeting and Brains Trust.

THE NEW INTELLECTUALS?

*by S. Gill**

The 1961 Western Joint Computer Conference, held at Los Angeles on 9–11 May, presented an interesting contrast between the general speakers and those delivering technical papers.

The opening speeches, by noted leaders of the American computer industry, proclaimed confidently the tremendous part to be played by computers in the future. Thomas J. Watson, President of *IBM*, in the keynote address said: "I can see no limit to the use of computers." Walter F. Bauer of *Ramo-Wooldridge*, who was Chairman of the Conference, said that computers would become the biggest business in the world, would surpass in size and in military importance both atomic energy and space technology, and would become a symbol of national prestige. The same sentiments were echoed by Simon Ramo in a luncheon address.

It is perhaps not surprising that, in contrast with these sweeping pronouncements, the technical papers were markedly cautious in tone. Now that their employers were convinced of the vast future for computers, scientists could afford to be frank about their actual achievements. Thus John McCarthy of MIT wrote in his paper on "A Basis for a Mathematical Theory of Computation" the following: "We hope that the reader will not be angry about the contrast between the great expectations of a mathematical theory of computation and the meagre results presented in this paper." Nevertheless, McCarthy's paper was stimulating, in showing the way towards establishing a firm foundation for programming, like that which now underlies other branches of mathematics. "In a few years' time," he remarked, "programmers will have to know as much mathematics as physicists do."

He was referring, of course, to those programmers who are concerned with extending the limits of the computer field. Present-day programming was dealt with by Ascher Opler of the *Computer Usage Company*, who was equally frank in surveying current problems in automatic programming. This, he said, was "not where it should be." Competition had gone too far, and both manufacturers and users had been unreasonable in demanding or attempting to produce too many automatic programming schemes. Recent change-overs from one machine to another had been painful, but it must be faced that there would be many more changeovers in the years to come. There would also be more variation in store sizes, numbers of tape units, etc., which was "sheer hell to automatic system developers."

On ALGOL and COBOL, Opler was cautious, saying: "Ultimately, the fate of standardised languages will depend upon their acceptance." These were the subject of another paper, by Jean Sammet, on "A Method of Combining ALGOL and COBOL." Progress in another approach to standardisation, UNCOL (Universal Computer Oriented Language), was reported by T. B. Steel of *System Development Corporation*. This had run into problems of data description. The present proposal was to use strings of characters as the basic form of data. Taking all characters in common use in Western civilisation a total of 811 was obtained; allowing these to appear also as subscripts or superscripts led to 2,433 distinct characters, which Steel described as "conservative." "Very clearly," he said, "UNCOL can be produced." They had now begun to develop the first version of UNCOL, and hoped to have trial translators within six to twelve months. He concluded his paper with these words: "Perhaps the whole approach is doomed to failure and oblivion, and then again, perhaps not. One thing at least is sure: experience and not dialectic will be the judge."

After listening to these sessions, the writer felt that the announced conference theme "Extending Man's Intellect" was a little presumptuous. Perhaps "stretching" would have been a better word. However, whatever the nature of the exercise, it was clearly challenging and, in the long run, as important as the opening speakers had said.

Introducing a session on the design of large computer systems, Charles W. Adams said: "The keynote in the design of new systems, whether large or small, is not hardware but logic." Developments were taking place in both fast and slow stores, but more important were the many new ideas being incorporated in the logical design of new computers, which seemed to show more variety than ever before (to the chagrin, no doubt, of Mr. Opler). Other speakers described the *Ramo-Wooldridge* AN/UYK-1, the *Ferranti* ATLAS, the new *Burroughs* B5000 and several other machines. Competition seemed as keen as ever.

The withdrawal of *IBM*'s STRETCH computer from the market had already been announced by Thomas J. Watson during his opening address. He made it clear that *IBM* now regretted having become involved in this project, which had entailed a considerable financial loss. The performance of the computer had not come up to expectations, and although commitments to supply it would be met, the price was being reduced in accordance with its reduced capability. Mr. Watson said that more advanced machines were now under development, but would not be announced at such an early stage as STRETCH had been.

Altogether it was an interesting three days. There was a session on "microsystem electronics," including "micrologic," which is "a compatible and sufficient set of integrated semi-conductor logic-function elements,"—obviously a vital aspect of "intellectronics." There was a session on "automata theory and neural models" led with great skill by Ross Ashby. There was a full and fascinating description of the *American Airlines* "Sabre" seat reservation system, soon to be installed. And all the while there was the exhibition, displaying several new developments in hardware, including in particular new storage and input–output devices. The programmers may have their headaches, but the engineers are obviously not going to let them have any rest.

* Ferranti Ltd.

INTEGRATED DATA PROCESSING IN BRITAIN AND AMERICA

Reported by Daphne P. Kilner

Introduction

A one-day Conference under this title was organised by the British Productivity Council in co-operation with the British Conference on Automation and Computation, British Institute of Management, Institute of Cost and Works Accountants, and held originally on 16 February 1961 with a repeat of the programme on 24 May 1961. Four papers were presented, one on the subject generally and three on particular case studies, as follows:

1. Integrated Data Processing and Computers:
   Brian A. Maynard, John A. Goldsmith, President and Editor of Report, respectively, European Productivity Agency's IDP Mission to USA.
2. An American Approach and Accomplishments to Date:
   W. F. Brackman, *Gillette Industries Ltd.*, formerly *Gillette Safety Razor Co., Boston, USA.*
3. IDP in Wholesaling and Retailing:
   Denis S. Greensmith, *Boots Pure Drug Co. Ltd.*, Nottingham.
4. IDP in Engineering Production:
   K. F. Turner, *Rolls-Royce Ltd., Derby.*

The Conference is a direct follow-up of the Mission which visited the United States from April to June 1960 under the sponsorship of the European Productivity Agency to study their progress and experience in Integrated Data Processing. The report of this Mission (Integrated Data Processing and Computers, published by the European Productivity Agency of the Organisation for European Economic Co-operation, November 1960) was circulated to members of the conference, together with its supplement, the Working Documents used or prepared by the participants during their various visits to American Data Processing Installations.

This short report on the Conference is based on the papers and discussion heard at its repeat on 24 May 1961 and seeks to elicit the main ideas on integration which were drawn out in the course of the day.

Integration

On the programme of this Conference, of the above title, the Integration of Data Processing (IDP) was defined as *the development of the most streamlined and automatic flow of data practicable within an organisation.* Added to this there was the note: *Through IDP there can be improved information to management by:*

Processing a wider range of inter-related facts
Showing only those results calling for action
Producing more timely results
It also facilitates cheaper production of routine documents.

Integration itself was the keynote of the day: the next ten years were apostrophised as the Decade of Integration, the speaker from *Gillette Industries* going so far as to suggest that the pioneering days of computers were now over. Probably the most important point made during the whole conference was that the idea and ideal of Integration in business exists apart from computers and should be pursued by any efficient firm regardless of whether they intended to use computers or not. Indeed, unless a firm already has an efficient integrated system as a basis, it will not get full benefit from the introduction of a computer. Computers will *widen* Integration but they will not bring it in of themselves. The title of the report of the Mission which anteceded this conference—Integrated Data Processing *and* Computers—bears out this point.

Few people have, however, really thought out what they mean by Integration. This term should imply a system or procedure covering the activities of an organisation from the lowest level to the highest, from the customer to the Chairman, from the initial recording of data, perhaps with the grubbiest of pencils, to the final act of the Managing Director using his gold-nibbed pen. The right perspective was seen in the *Boots*' IDP system (and in some American Banks) where the customer was taken as the focal or starting point. The Integration procedure began with the transactions that took place over the 12 inches of counter-space in each of their branches: here was the dog that wagged all the other tails and set the whole resulting IDP system in motion. Nevertheless, most people's ideas on Integration fall short of this concept and few companies have visualised a complete, overall picture, where all processes are interdependent in this way and no part of the business activity is left outside the system.

This sense of perspective is necessary to give an economic balance to the system. *Boots*' discarded one of their plans for recording data at the point of sale as being uneconomic; their average sale was 3s. 6d. and the price of the recording method was increasing the cost of the sale too much. *Rolls-Royce* have a similar problem in finding suitable equipment for communicating between the shop-floor and the computer centre and found nothing in the right price range, i.e. something like £50 a point.

The USA has a lead over the UK in this field for many reasons. Mechanisation has always been more widespread there than here due to differing economics. Wages there were higher although the cost of equipment in the two countries was roughly the same, therefore the incentive to mechanise was greater. Punched cards have long been used in the USA as documents to pass between companies in a way unknown over here. The existence of larger companies and a Government more active in this sphere were also factors which made the USA better pioneers in the mechanised field, although it was an interesting point that the proportion of small firms in the USA was actually greater than in the UK, but there were also more larger firms. They started to use computers in business no earlier than this country, but they had this more mechanised basis on which to do it

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with the result that they are today well in the lead with round figures of 5,000 computers installed and 6,500 on order and several large firms already using IDP.

Making a Start

Slower starters have the advantage of being able to benefit by the early mistakes of others, mistakes such as underestimating the cost of parallel running between old and new systems and overestimating clerical savings. It is safe to conclude that one can never justify IDP on the ground of savings in staff alone, but only by taking into account the advantages it will bring in better control, speedier results, greater accuracy, lower cost, and in the possible increase in business it will probably bring. Substantial staff savings have only been achieved in the USA by the very large concerns. The comedy/tragedy of purchasing a computer as a status symbol will probably never be repeated here, but it might still be possible to underestimate the initial studies needed: 5, 10, or 15 years are periods of time not too long to think of for the introduction of a computer and 30/40 man-years for the cost. IDP cannot be rushed.

The problem with Integration is: How does one start? What is the best method of applying these vital changes? A piecemeal or a wholemeal approach? Can one really move from the present system, whatever it is, to a fully integrated affair, that is, the one-shot approach, or is it wiser to go-slow and pass through various intermediate stages first? Both approaches have been made but the one-shot approach now seems to be in disfavour because it is too complex and too costly. Replacing it is the method adopted by both *Rolls-Royce* and *Boots*', and in some instances also in the USA, in which a framework or overall plan for full integration is first produced but only one area or facet of this framework is implemented in detail at a time.

There were many stages a business could pass through on the way to full Integration: indeed there were many preliminary aids which should be used before entering on a study to make an overall scheme. Integration, as has already been said, can be introduced apart from computers, and every efficient firm should consider integration of existing data through better design of forms and the apt use of carbon paper, and so on, to provide a good administrative basis as a first step towards the wider integration which computers will bring. There has been an extraordinary growth recently in fringe equipment which could be used as aids to integration apart from computers, where formerly there was not much more than the conventional punched card equipment. The possession already of a good mechanised system using punched cards is a flying start towards a computer-integrated system; the employment of the usual O & M techniques to improve administration and the experience which can be gained through hiring time at a computer service bureau are both also valuable preliminaries. In fact unless you have these, or some of these, already you are probably at a disadvantage in trying to arrive at IDP. The situation has changed a little more recently, too, through the development of "expanding" computers by selecting and adding as required modules of computing equipment. There are few computer systems of the second decade which are not designed in this way and it could be a valuable asset in the slow implementation of an IDP system.

A computer, it must be re-iterated, is only one tool, even if a major one, in Integration. It is significant that it has not yet rendered any of the earlier tools, such as punched cards, obsolete: rather the general effect has been to increase their use. No conventional IBM punched card equipment, for example, was returned by the *Gillette Co., USA*, after their IBM 650 computer was introduced. There will always be some situations in which conventional punched card equipment is best; there will always be some jobs best done by pen and ink! Computers should not be used to take over existing punched card procedures nor indeed to fit the present situation at all. The computer is rarely an efficient means of mechanising a single task: this must be integrated with other activities and the situation thought out afresh with equipment chosen for the various aspects of it which is the most suitable. The biggest single difference that the introduction of computers has made is to highlight the necessity for the detailed systems study and to foster a new appreciation of the intricacies of the work of the humble clerk. For it is in trying to unravel the logical steps of clerical work to programme these for computers that one realises the amount of judgment a clerk has to use, even unconsciously, in scrutinising and vetting papers: the computer will not do this unless programmed in advance to do so. The speaker from *Boots*' also added that in planning his new system he had spent as much time on problems of accommodation and personnel as he had on working methods.

Change in Outlook

Integration itself brings problems in its train, both while it is being thought out and implemented, and afterwards. A great many of these, if not most of them, revolve around management. Firm management direction is needed right from the beginning of the study and throughout its implementation: it is they who must be the prime movers from the centre, not the specialists whose function is merely to advise and formulate proposals. A change in outlook on the part of management will be necessary. There will no longer be any need to postpone decision owing to lack of information: information is going to be right up to date and the moment of decision will arrive much sooner. In fact, so much information is going to be available for ready analysis that it will be encumbent upon management to look further ahead, to select in advance the information required to produce action and to give a decision beforehand on which figures it actually needs. IDP will make greater demands altogether on executive authority and increase its responsibilities. The change in outlook required is probably best brought home by considering the speed at which the computer works and the relative time-scales involved: nowadays computers work in microseconds and one microsecond is to a second as one second is to twelve days!

Management support and direction is particularly essential where departmental boundaries have to be crossed or broken down. IDP in the *Gillette Co., USA*, resulted in significant changes in the firm's structure and in the creation of a new post, Director of Information, who had on his staff flow specialists in various aspects of data processing.

All this means a certain re-education of management. The success of the *Boots*' IDP venture was ascribed in no small way to the willingness of their management in the early days to attend appreciation courses and to learn to use these systems: such an attitude on the part of management is now regarded as a fundamental cause of the successful development of the system. One of the lessons learned in the pioneering days of the last five years has been the lack of educational facilities in this field for management at all levels.

There is a problem here which has to be faced in making the most of these new tools.

Many other changes will come through IDP. There will have to be greater centralisation and pooling of records in the future: each department will no longer be able to maintain its own records, nor to claim sole right to them. As has been said, IDP results in changes in company structure, breaking down existing departmental boundaries and creating new posts such as Director of Information or Data Processing Manager, and these posts, to be effective, must be on a par with other executives.

But at lower levels it brings changes too. Inflexibility and too much uniformity are among the pitfalls of integration, but greater discipline and accuracy are its essentials. This applies on the shop floor and in the paper-handling work in offices. No useful results can ever be obtained from a computer unless its input is accurate and from this it could be said that the most important person in the system is the one who enters up the source data. If necessary, people must be trained in accuracy for the cost of correcting errors was enormous. In this connection several speakers at the conference (including those from *Rolls-Royce* and *Boots*') endorsed the value of mark-sensing techniques, but they added a proviso that the operators, those actually marking the cards, needed careful training beforehand. This was the secret of making the system work. *Boots*' successfully employ 5,000 youngsters to mark these cards but they ran the scheme for 12 months before the computer arrived. This discipline will also apply in the computer room, one speaker saying he did not think that enough weight was given to operating instructions in designing programmes. There was not enough co-operation between operators and programmers.

However, redundancy of staff has been proved to be emphatically *not* an IDP problem nor a problem of the introduction of computers generally. No noticeable redundancy has yet arisen, this being taken care of by the normal wastage, by re-training of staff for other work and by the expansion of business which computers make possible. Anticipated staff savings tend in any case to disappear in the staff required around the computer! It should be noticed that the *Gillette Co., USA*, also retained their programming personnel after the new system began: such staff did not suddenly become idle because the necessary programmes had been written. Nothing is static in commercial work: re-programming is always necessary. There is no problem of redundancy in IDP but there may be one of re-training.

Conclusion

In summing up, the Chairman, Sir Walter Puckey, made the most interesting comment that whereas the computer will do the work of 100 ordinary people, no computer can do the work of one exceptional man. We have now superb equipment: we still need men of great quality.

THE DATA PROCESSING AND COMPUTER SOCIETY OF NEW ZEALAND

Mr. H. F. Foster, Honorary Secretary, has reported to us on the formation of an incorporated Society in New Zealand, after about two years of preparatory work by a small group. The following paragraphs are taken from the President's circular to members of that Society, dated 17 May 1961.

Inaugural Meeting

Those who were unable to be present will be pleased to learn of the success of the inaugural meeting held at Victoria University of Wellington on 12 April 1961. More than 100 people attended and listened with interest to addresses given by Dr. R. M. Williams, Director of the Applied Mathematics Laboratory of the Department of Scientific and Industrial Research (N.Z.); Mr. K. V. Hills, a public accountant; and Mr. F. M. Henderson, Senior Lecturer in Civil Engineering of the University of Canterbury, on the application of computers in various fields. Mr. G. V. Oed outlined the aims of the Society. The meeting was under the Chairmanship of Dr. J. Williams, Vice-Chancellor of Victoria University, Wellington.

The N.Z. Executive Committee is examining the possibility of having these addresses reproduced for distribution to members in N.Z.

Executive Committee

At a general meeting of those who were members of the Society at the time of application for its incorporation, the following officers and committee were elected:

> *President:* Mr. G. V. Oed, B.Com., A.R.A.N.Z., of the Accounts Branch of the Post and Telegraph Department, Wellington. *Committee:* Mr. W. L. Birnie, F.R.A.N.Z., F.C.W.A., Secretary of Cable Holdings Ltd.; Mr. A. W. Graham, B.Com., F.R.A.N.Z., Secretary N.Z. Society of Accountants; Mr. E. W. Jones, M.Sc., of the Applied Mathematics (Laboratory, Department of Scientific and Industrial Research (N.Z.); Mr. W. G. Rodger, B.Com., F.P.A.N.Z., Head of the Department of Accountancy, Victoria University of Wellington; Mr. P. N. Walker, M.A., B.Com., D.P.A., Controller of Mechanical Accounting, Treasury, Wellington. *Secretary:* Mr. H. F. Foster, A.P.A.N.Z., F.C.A.I., F.C.I.S., has agreed to continue in the capacity of Secretary.

While the rules provide for a committee of seven members, only five have been nominated and elected. This will give the committee the opportunity to co-opt two additional members from those who have joined the Society recently.

Data Processing Course at Victoria University of Wellington

Arrangements are being made by Victoria University for a course in data processing to be conducted during the second term of the current year. This is being planned to cater for those who have little or no previous experience with punched cards, as some basic knowledge of these is the first step to understanding computer techniques.

Proposed Study Groups

Mr. E. W. Jones of the Executive Committee has been appointed Convener of a sub-committee to set up study groups to suit the varying needs of different sections of our members. Further information will be available on this later.

Activities in other Centres

The N.Z. Council is mindful of the need to cater for the requirements of members in all main centres. It is hoped that from time to time arrangements may be made for speakers who have prepared addresses to repeat them on occasions when they are visiting other centres. However, the Society is still at an early stage of its development, and the wider spread of its activities will evolve in due course.

General

In conclusion it is emphasised that the Society does not cater solely for the expert or the specialist. It is intended primarily as a study group to enable a greater dissemination of information on the use of computers. The companies distributing this type of equipment in New Zealand have indicated that they will give the Society their full support. Communications should be addressed to P.O. Box 243, Wellington, N.Z.

BCS Publications

Members of the N.Z. Society may subscribe to BCS Publications through their local Society at advantageous rates. Details may be obtained from P.O. Box 243, Wellington.

PUNCHED CARD SURVEY

During 1960/61, the Input/Output Study Group of the Society attempted to make a survey of a number of punched-card users, all in the UK. The main objective of the survey had been to establish the residual-error factor in punched cards, after verification, in order to judge its effect when cards are used as a computer input, and the need for a validity check. In the process of making the survey, a number of other facts emerged which are of interest, although not directly related to the error rate.

The first fact to emerge was that the questionnaire had not been sufficiently skilfully prepared. This resulted in a few questions being answered in different ways by various users, somewhat nullifying the usefulness of the replies. The Society is grateful to those users who took the trouble to reply; it must be reported that in some installations, users are not apparently provided with reliable figures, since the variations in reported results were too wide to be due to any factors which are capable of explanation.

Among the usable results of the survey, we can report that of 160 users circulated, 60 (37·5%) provided answers, but not necessarily to all questions. Of these 27 (45%) used Hollerith machines, 26 (43·3%) used Powers machines and 7 (11·6%) used IBM machines. All users reported that they used verifiers supplied by the manufacturers as a means of checking original punching and all reported that doubtful data was referred to a supervisory level for a decision.

Numeric keyboards were used in 54 of the installations and alpha-numeric (typewriter) keyboards in the other 6. Of the 6 typewriter keyboards, 5 were IBM users and 1 a Hollerith user. Both manual and automatic punches were used in 5 installations; in 10 Hollerith installations, manual punches only were used. 53 users stated that their installations were centralised; no users reported decentralised installations and 7 did not reply to this question.

The data supplied by the users were based sometimes upon one or sometimes upon several jobs carried out in an installation. Of 66 jobs forming the basis of the replies, 34 punching documents were originated specially at source, 18 by transcription on to specially designed forms at the punched card centre and 14 as a by-product of other documentation.

On the question of legibility of the documents, 49 were in ink or part ink, 31 in pencil or part pencil, 24 were typed (including carbon copies), 1 was from an accounting machine and 1 was part pre-printed. Only 9 jobs required the operator to carry out encoding operations during punching.

From 54 replies, 7 users had punch operators all of GCE Ordinary Level, whilst a further 8 had some of this standard.

The results obtained from the questions relating to operators' age-groups, length of experience, key depressions per card, punching speeds and residual errors showed considerable variability which it is felt was partly due to misunderstandings when the questionnaire was completed. The Study Group therefore proposed to devise a new questionnaire during the 1961/62 session and invite users to keep certain records for a sample period in a uniform format. These records will then be analysed and each contributor will receive a report on his figures and the total figures.

A notice will appear in a future issue of *The Computer Bulletin* inviting co-operation from those users who will be prepared to co-operate in this further study. The Chairman of the Study Group is Mr. A. S. Waller, *Lamson Paragon Limited*, Paragon Works, London, E.16.

The 1960/61 survey has been a useful pilot study, which it is hoped will enable a more complete study to be made in the near future.

COMPUTER COURSES 1961–62

The Editor has received details of courses in Educational Institutes. Details of additional courses will be published in the next issue of the *Bulletin* if the information reaches the Editor by 16 October 1961.

Courses

Courses	*At*	*Commencing*	*Fee* £	s.	d.	*Lectures*	*Times*
Computer Programming	Battersea College	26 January	1	0	0	12 weekly lectures	6.30–8.30 p.m.
Data Processing Machines	Borough Polytechnic	2 October	1	0	0	12 weekly lectures	At 6.30 p.m.
Digital Computer Programming	Borough Polytechnic	6 October		10	0	6 weekly lectures	At 6.30 p.m.
Partial Differential Equations	Brunel College	5 October	1	10	0	18 weekly lectures	7.00–8.30 p.m.
Programming Elliott 803	Brunel College	4 October	1	0	0	10 weekly lectures	7.00–8.30 p.m.
Numerical Methods	Brunel College	3 October	2	0	0	20 weekly lectures	6.30–9.00 p.m.
MERCURY Autocode	Brunel College	2 October	1	0	0	10 weekly lectures	7.00–8.30 p.m.
Chebyshev Polynomials	Brunel College	2 October	1	0	0	10 weekly lectures	7.00–8.30 p.m.
Digital Computers	City of London College	17 January				10 weekly lectures	5.30–7.00 p.m.
PEGASUS Autocode	Durham University	27 September	4	4	0	Full-time	3 days
PEGASUS Programming	Durham University	13 November	20	0	0	Full-time	2 weeks
Introduction to Computers	Ealing College	12 October				10 weekly lectures	9.30 a.m.–12.30 p.m.
Advanced Course on Computers	Ealing College	11 October				10 weekly lectures	1.30–4.30 p.m.
DEUCE Interpretive Scheme	Glasgow University	9 October	10	0	0	9–20 October	2.00–5.00 p.m.
DEUCE STAC Programming	Glasgow University	9 January	15	15	0	9–26 January	2.00–5.00 p.m.
DEUCE Interpretive Scheme	Glasgow University	30 April	10	10	0	Full-time	5 days
Numerical Analysis	Glasgow University	9 October	(Details from Secretary, Computing Laboratory)				
Linear Algebra	Hatfield College	9 October	1	0	0	10 weekly lectures	5.15–6.45 p.m.
Interpolation	Hatfield College	9 October	1	0	0	10 weekly lectures	7.30–9.00 p.m.
Curve Fitting and Chebyshev Approximation	Hatfield College	12 October	1	0	0	10 weekly lectures	4.30–6.30 p.m.
Boolean Algebra	Hatfield College	9 October	1	0	0	10 weekly lectures	4.30–6.30 p.m.
Digital Computers	Hatfield College	13 October	1	0	0	10 weekly lectures	6.00–8.00 p.m.
Finite Differences	Imperial College	10 October	8	8	0	24 weekly lectures	
Matrices	Imperial College	10 October	8	8	0	24 weekly lectures	
Numerical Methods	Imperial College	10 October	4	4	0	12 weekly lectures	
Integral Equations	Imperial College	21 November	4	4	0	12 weekly lectures	
Ordinary Differential Equations	Imperial College	28 January	8	8	0	24 weekly lectures	
Partial Differential Equations	Imperial College	23 January	8	8	0	24 weekly lectures	
Computing Machines	Imperial College	23 January	8	8	0	24 weekly lectures	
Numerical Analysis	Lanchester College, Coventry	25 September	1	12	0	27 weekly lectures	6.30–9.00 p.m.
Boolean Algebra	Lanchester College, Coventry	3 May	1	2	0	8 weekly lectures	6.30–8.30 p.m.
Programming Elliott 803	Lanchester College, Coventry	11 January	1	2	0	10 weekly lectures	6.30–8.30 p.m.
Analogue Computers	Lanchester College, Coventry	Spring 1962	1	2	0	Full-time	2 days
Numerical Analysis	Leicester College	19 September	1	10	0	30 weekly lectures	6.30–8.30 p.m.
Computers for Industry	Leicester College	25 September	1	10	0	10 weekly lectures	6.45–8.15 p.m.
ZEBRA Simple Code	Leicester College	20 September	1	10	0	12 weekly lectures	6.45–8.15 p.m.
ZEBRA Simple Code	Leicester College	10 January	1	10	0	12 weekly lectures	6.45–8.15 p.m.
Electronic Data Processing	Leicester College	21 September	1	10	0	12 weekly lectures	2.00–5.00 p.m.
Electronic Data Processing	Leicester College	11 January	1	10	0	12 weekly lectures	2.00–5.00 p.m.
Analogue Computing	Leicester College	28 May	5	0	0	Full-time	5 days
Electronic Data Processing	Leicester College	25 June	5	0	0	Full-time	5 days
MERCURY and other courses	London University Computer Unit	(Details from 44 Gordon Square, London, W.C.1)					
EDP Equipment	Manchester College of Commerce	27 September	2	10	0	15 weekly lectures	6.00–8.00 p.m.
EDP Systems	Manchester College of Commerce	9 October	2	10	0	15 weekly lectures	6.00–8.00 p.m.
PEGASUS Programming	Manchester College of Commerce	25 September	2	0	0	12 weekly lectures	6.00–8.00 p.m.
IBM 1401	Manchester College of Commerce	26 September	2	0	0	12 weekly lectures	6.00–8.00 p.m.
ICT 1301	Manchester College of Commerce	28 September	2	0	0	12 weekly lectures	6.00–8.00 p.m.
UNIVAC 80	Manchester College of Commerce	29 September	2	0	0	12 weekly lectures	6.00–8.00 p.m.
Logical Design and Circuits	Northampton C.A.T., London	25 September	3	3	0	22 weekly lectures	6.30–8.00 p.m.
ICT COBOL	Northampton C.A.T., London	25 September	2	2	0	10 weekly lectures	6.30–8.00 p.m.
Digital Differential Analyser	Northampton C.A.T., London	3 October	2	2	0	10 weekly lectures	6.30–8.00 p.m.
IBM 1400 Series	Northampton C.A.T., London	26 September	2	2	0	12 weekly lectures	6.30–8.00 p.m.
ORION Applications	Northampton C.A.T., London	4 October	2	2	0	10 weekly lectures	6.30–8.00 p.m.
Digital Computing (Introduction)	Northampton C.A.T., London	28 October	2	2	0	12 weekly lectures	6.30–8.00 p.m.
Computing for Civil Engineers	Northampton C.A.T., London	28 September	21	0	0	24 weekly lectures	3.30–7.00 p.m.
Engineering Design by Computer	Northampton C.A.T., London	26 September	2	2	0	12 weekly lectures	6.30–8.00 p.m.
Numerical Methods	Royal College, Glasgow	5 October	2	10	0	20 weekly lectures	7.00–9.30 p.m.
Electronic Computing I	Sir John Cass College	25 October	1	0	0	6 double weekly lectures	6.15–8.30 p.m.

Courses	*At*	*Commencing*	*Fee* £ s. d.	*Lectures*	*Times*
Electronic Computing II	Sir John Cass College	17 January	1 0 0	6 double weekly lectures	6.15–8.30 p.m.
PEGASUS Autocode and Matrix Scheme	Southampton University	26 September	5 5 0	Full-time	2 days
Industrial Management	Wolverhampton College	2 October		10 weekly lectures	At 7.30 p.m.
WITCH Programming	Wolverhampton College	17 January		10 weekly lectures	At 6.45 p.m.
Computational Methods	Woolwich Polytechnic	25 September		30 weekly lectures	6.30–9.00 p.m.
Introduction to Computers	Woolwich Polytechnic	28 September		6 weekly lectures	7.00–9.00 p.m.
Business Applications of Computers	Woolwich Polytechnic	9 November		12 weekly lectures	7.00–9.00 p.m.
Scientific Applications of Computers	Woolwich Polytechnic	8 November		12 weekly lectures	7.00–9.00 p.m.
ZEBRA Simple Code	Woolwich Polytechnic	21–22 February		6 weekly lectures	7.00–9.00 p.m.
Analogue Computers	Woolwich Polytechnic	26 September		6 weekly lectures	6.30–8.30 p.m.

Computer Manufacturers

It has not proved possible to summarise the variety of courses offered. Much helpful literature is available and it is suggested that interested readers write to:

AEI Ltd.	K. C. Evans, Electronics Apparatus Division, Trafford Park, Manchester 17.
Bulmers (Calculators) Ltd.	A. R. Rider, 47–51 Worship Street, London, E.C.2.
Elliott Bros. (London) Ltd.	F. S. Ellis, Elstree Way, Borehamwood, Herts.
EMI Electronics Ltd.	J. W. Godfrey, Computer Division, Hayes, Middlesex.
English Electric Co. Ltd.	J. Boothroyd, Data Processing and Control Systems Division, Kidsgrove, Stoke-on-Trent, Staffs.
De La Rue Bull Machines Ltd.	114–118 Southampton Row, London, W.C.1.
Ferranti, Ltd.	R. Wilkinson, 21 Portland Place, London, W.1.
Honeywell Controls Ltd.	Honeywell EDP Division, Greenford, Middlesex.
IBM United Kingdom Ltd.	The Education Department, 101 Wigmore Street, London, W.1.
ICT Ltd.	F. A. Worsfold, Bradenham Manor, nr. High Wycombe, Bucks.
Leo Computers Ltd.	R. P. Gibson, Hartree House, 151A–159A Queensway, London, W.2.
National Cash Register Co. Ltd.	D. H. Triggs, 206–216 Marylebone Road, London, N.W.1.
Standard Telephones and Cables Ltd.	F. G. Filby, Information Processing Division, Corporation Road, Newport, Mon.

Note.—The Editor regrets the omission of several courses, details of which arrived too late for inclusion.

REGIONAL BRANCH NEWS

BELFAST

The activities of the branch through the winter 1960–61 have been as follows:

13 *October*

A film evening; the films shown were: *The Search at San José*, *Insurance Application of Perseus*, *Leo the Automatic Office* and *The Electronic Computer in Commerce*.

10 *November*

Mr. J. Girling of *ICT Limited* gave a talk on Production Control, illustrated by slides.

12 *January*

Members and friends visited the ICT factories at Castlereagh. Manufacture and application of their range of equipment were demonstrated.

26 *January*

Mr. R. A. Brooker of Manchester University spoke on Computer Languages. His subject was a universal translator for computer languages.

9 *February*

Professor Kilburn discussed ATLAS the large sub-microsecond machine designated MUSE in its development at Manchester University.

9 *March*

Mr. D. B. Owles of IBM Insurance Section, gave an informative talk on the problems of the Graduated Pension Scheme.

20 *April*

"Off the Beaten Track." A summary of the variegated applications of the Queens University DEUCE.

BIRMINGHAM

Recent meetings of the Birmingham Branch have been concerned with the design of digital computers and their application to problems in heavy industry.

On the 7 December Dr. R. J. Orde-Smith described the

design of the STANTEC-ZEBRA computer and some of the problems it has solved. This computer is unique in that very little decoding of the function part of the rather long instruction word is performed, and most of the digits operate gates in the machine directly. Thus, of the 33 instruction digits, 15 are function digits, so that a great variety of instructions may be used, and in many cases several operations may be performed simultaneously. Although a fixed point machine, a simple code permits floating-point operation by program, and a recent version has facilities for many input and output channels, including magnetic tape.

Dr. Orde-Smith gave illustrations of some of the complex instructions which could be used, and pointed out the economy in apparatus and initial cost permitted by the design. The lecture was concluded with short descriptions of typical problems ranging from the evaluation of multivibrator circuits subject to the influence of component tolerances, to the re-organisation of postmen's rounds.

On the 11 January Messrs. C. Robinson and J. Boothroyd described "New Trends in Computer Instruction Codes" with reference to the KDP 10 and KDF 9 computers. The former is a 2-address machine intended for commercial data processing, with a large core store constructed in 16,000 character blocks, magnetic tape input and output, and a high speed output printer. The basic unit of information is the "character" comprising 6 bits and a parity check bit, so that numerical and alphabetical data may be directly encoded. A novel feature of the design is the assembly of the data into "items" and "messages" with no specified length. This is particularly convenient for alpha-numerical data, which consequently does not require padding out to a fixed number of characters per word, so that storage space is conserved.

The KDF 9 computer on the other hand is intended for high-speed scientific and engineering calculations, and so uses a fixed word-length of 48 bits. A particular feature of this machine is the use of a high-speed nesting store, of 1 μs cycle time, in which each word inserted pushes down the existing contents one place, and from which only the top word may be extracted. Special orders are available to re-shuffle the contents of the nesting store to facilitate certain operations, and its use shortens the length of a simple arithmetic instruction to only 8 bits. More complex instructions may occupy 16 or 24 bits.

This lecture introduced new design and programming facilities to most of the audience, and generated a keen discussion of these features.

On the 8 February, Mr. D. G. Owen discussed the use of a computer in Operational Research, in a large steel company. One typical problem is the cutting of long billets of steel into ordered lengths with the minimum of waste. The computer can be employed in two ways: to investigate the effectiveness of various rules used by the operator, or "on-line" to control the actual length of each billet in conjunction with a length measuring device.

A great deal of work has also been done on a general process-simulation program, and a general statistical reduction program, which includes a number of operations such as correlation and regression analysis, and prints out bar histograms of all variables.

Mr. Owen concluded by describing a simulation project in which the computer was used to represent part of a particular steel plant, and the management were brought in to make the operating decisions normally required to work the actual plant.

This exercise gave valuable information about the relative merits of various operating strategies.

The final lecture of the session was given on 8 March by Mr. N. M. Rolfe of the *Birmingham and Midland Omnibus Co. Ltd.*, on "Practical experience with a small computer." Mr. Rolfe explained why his company decided to purchase a computer, the nature of the clerical and administrative work it handled, and the ways in which it has helped the company's operations.

At the Annual General Meeting on 8 May the usual business was followed by an interesting and amusing programme of films kindly lent by several computer manufacturers, so providing an enjoyable conclusion to a successful session of Branch activities.

HULL

Total attendance at the 10 meetings of the past year has been approximately 310. This is less than in the previous year, though we may note that the proportion of guests attending has fallen considerably from over 60% in 1959–60 to about 45% this year. Consequently the total attendance of members, at 180, is the same as in the previous year.

The attendance at our meetings suggests that the programme was adequately balanced to interest both the commercial and scientific sides of our membership.

The outstanding meeting of the year was that held in July 1960 and addressed by Mr. A. W. Howitt on "The Use of a Computer in Auditing Problems." On this occasion we were privileged to be hosts to members of the Society's conference being held at Harrogate who earlier in the day had visited the computer installations at *Blackburn Aircraft Company Limited* and at *Reckitt and Sons Limited.* In December 1960, for the first time, we held a joint meeting with another of the professional societies of the area—in this case, the Brough branch of the Royal Aeronautical Society, the meeting being addressed by Dr. S. H. Hollingdale on "Some Aeronautical Applications of Computers." We trust that this innovation in our programme will be repeated in future years. Finally, in any survey of this year's programme, mention must be made of the outstanding lecture by Professor T. Kilburn on the new Manchester University computer, the prototype for ATLAS.

Increasing recognition was given to the Society in its standing as one of the professional societies in Hull. An important activity was our participation at the invitation of the Hull Electronic Engineering Society and the Institute of Electronics in the electronic exhibition and convention held at Farmery Hall in September 1960. Despite initial difficulties in obtaining exhibition material, the stand was successfully set up and many of the 4,000 who attended the exhibition displayed great interest in our Society.

The programme for the coming year has been under active consideration by the Branch committee and is now almost complete. We hope to have talks on topics such as: Adaptive Processes in Automatic Control, Production and Stock Control, School Timetables, Market Research, Analogue Computers and Advanced Programming with speakers such as Dr. S. Gill, Dr. A. S. Douglas, Mr. D. Greensmith and Dr. B. V. Yule, together with lecture-demonstrations of an Elliott 803 computer and an EAL TR 10 at our meetings.

BOOK REVIEWS

Thinking Machines

By Irving Adler, 1961; 189 pages. (London: *Dobson Books Ltd.*, 18s. 0d.)

The subtitle of this book suggests that it is: "A Layman's Introduction to Logic, Boolean Algebra and Computers," and it is upon those topics that its worth must be judged. It must be said at the outset that, considered as an introduction to computers the book is, in any sense, a failure. There are numerous errors, or more properly half truths, of fact, even in the introduction: for example the statement on p. 11 that a machine was specially wired to play a good game of checkers, whereas what is probably meant is the Samuel program for this purpose. Again, on p. 12, the suggestion that computers are actually translating books and magazine articles is false. To end this introductory chapter, it is suggested that computers cannot simulate creative thought processes because the latter may result from random processes. It may be, and probably is, true that machines will not soon rival humans in this field, but it is certainly untrue that this is due to a lack of facilities for random action.

This somewhat unrewarding introduction is followed by an account of tools, elementary automation and feedback, and leads, *via* a chapter with the intriguing title "Getting an idiot to think," to an elementary description of a Turing machine. This description the reviewer found quite incomprehensible despite previous conditioning to an acceptance of incomprehensibility by long familiarity with Turing's own papers on the subject.

The next section of the book deals with arithmetic and its logical foundations and thence to a description of elementary calculating machines. This is quite well written but contains some curious statements such as that which occurs on p. 55: "The best known of analog computers is the *differential analyser* built at the MIT." This may be true in the USA but, even there, it seems to the reviewer that the slide-rule has a greater title to fame.

The next 82 pages are concerned with logic, Boolean algebra, and switching circuits. These sections contain one of the best elementary accounts of the subject which we have seen and can be thoroughly recommended. It is perhaps an ungrateful quibble to remark that the author's most complex "puzzle"—"Who is the Engineer?" on pp. 111–114 was solved by the reviewer, in his head, in 45 seconds whereas the analysis by Boolean algebra takes two pages, and that the example of circuit simplification on pp. 145–146 was similarly treated in 10 seconds. These criticisms are, however, not really due to the author but merely to those enthusiasts who continually "plug" the use of a complicated substitute for elementary common sense.

To conclude the book the author selects the IBM machine NORC for description. This is not only un-typical of modern practice but is far too complicated a system for a book of this type, and the reader is most unlikely to have much idea of how an all purpose digital computer works when he has read the relevant text.

The book is relatively inexpensive so that, for this reason alone, it may be serviceable for the chapters on Boolean algebra. For any other purpose, however, it cannot be recommended.

A. D. BOOTH

British Miniature Electronic Components and Assemblies Data Annual 1961–62

Ed. by G. W. A. Dummer and J. M. Robertson, 1961; 504 pages. (London: *Pergamon Press Ltd.*, 80s. 0d.; New York: *Pergamon Press Ltd.*, $15.00.)

This book is basically a bound collection of manufacturer's current technical literature covering miniature components (excluding transistors) up to about 1 in. cube. Some larger components are included where they are the smallest of their type. The editors have added some useful information on the effects of potting resins, high altitude, vibration, nuclear radiation and soldering but the reader cannot help feeling that the files of the Royal Radar Establishment must contain detailed criticisms of these components which would be of greater value. As it is, he must be content to note in the Preface that the Editors "have endeavoured to be selective in presenting data on the better quality components only."

C. D. MARSH

Some Commercial Autocodes: A Comparative Study

By E. L. Willey, A. d'Agapeyeff, Marion Tribe, B. J. Gibbens, Michelle Clark, 1961; 53 pages. (London: *Academic Press Ltd.*, 15s. 0d.)

This is the first of an intended series of studies in data processing to be published for the Automatic Programming Information Centre, Brighton. The authors are members of the BCS Discussion Group on Advanced Programming. This study compares a number of features of 8 languages, all developed in recent years to simplify computer programming of "commercial" applications. The languages considered are FLOWMATIC, Commercial Translator (IBM), COBOL, CODEL, NEBULA, Elliott Bros. Business Language for Computer Programming, FACT, and SEAL.

Many aspects of these languages are omitted, in particular the authors acknowledge that they have deliberately not dealt with data description. Although it is true that this is a difficult subject for comparison it is so important that no publication which sets out to give an adequate description of a commercial autocode can afford to omit this side of the procedure.

The comparison is in fact limited to the main features of the procedure description. The similarities and differences between the chosen languages are neatly displayed by setting down the statements required in a number of common situations, for each language. Illustrations are given of many arithmetic and conditional statements, of counting and switching procedures, of facilities for labelling statements, and of other features.

Where the authors consider that one language allows a particularly neat way of specifying some procedure, the statement is ringed. Apart from this—and the telling "Not Available," where a procedure cannot be expressed in a language—the authors give no opinions on the languages.

There is a bibliography, which should be treated with caution. Thus the (original) version of the Commercial Translator manual, F28–8013, listed here is clearly not that used by the authors in preparing their examples (e.g. the operation word ADD does not appear in this manual); a later version F28–8043 (1960) introduces itself as "a major revision of . . . F28–8013, which is obsolete and should be destroyed."

A great deal of information has been packed into these few pages, but it is necessarily condensed and there is very little by way of introduction to prepare the way for the uninitiated. This study will be of interest to those familiar with at least one of these languages, or some similar, and especially to those who have helped to implement any of them. Perhaps to these last it will, by its very conciseness, show the chaos resulting from the desire to go one's own way in devising a business language, which still seems fashionable.

A. J. MITCHELL

Modern Computing Methods

By The National Physical Laboratory; Notes on Applied Science No. 16, 1961; 170 pages. (London: *H.M.S.O.*, 21s. 0d.) Second Edition.

One has only to compare this new edition of *Modern Computing Methods* with the earlier edition to appreciate the great change which has come over scientific computation as a result of the development of digital computers and of the intensive work in numerical analysis that they have stimulated. The new edition, like the first, opens with chapters on linear equations and matrices. These chapters are, however, much extended and less attention is given to methods suitable for computation with desk machines. The process of pruning away out-of-date material will no doubt be carried even further when the third edition is being prepared. There is one statement in the introduction to the bibliography that I feel must have been left in by mistake. It is to the effect that programmers must be acquainted with the fundamentals of good desk machine practice before they can be efficient and reliable. I believe that few people would now advocate an apprenticeship on desk machines for programmers, and I am quite certain that the young would not put up with it even if they did.

The chapters on linear equations and matrices are of particular value, since the subject owes much to work done at the National Physical Laboratory. These chapters will, pending the publication of a really good and comprehensive book on matrix methods, be of real value. I note, by way of comment rather than criticism, that the text is inclined towards the use of fixed point arithmetic rather than floating point arithmetic. I was glad to see Givens's methods explained, even if rather briefly. It is a good point also that the reader's attention is drawn to the advantages of Householder's method; no doubt the section on this method was inserted into the text too late for a full description to be included.

The section on linear equations and matrices is rounded off with a chapter on error analysis. This contains an account of the approach used by Wilkinson in which the solution obtained by the method under discussion is interpreted as being the exact solution to a perturbed problem. If the numbers occurring in the perturbed problem differ from those occurring in the original problem by quantities comparable with the rounding errors, it may be concluded that the method in question gives, under normal circumstances, as much accuracy as the data warrant. This very neatly side-steps a difficult mathematical problem, and pleases all except those mathematicians who feel that they are cheated of a nice juicy problem. I hope that the section on linear equations and matrices will be even further expanded in future editions; it may prove possible to give more precision to the methods described by making use of ALGOL notation.

The chapters on finite difference methods and the solution of ordinary differential equations give a concise summary of the traditional methods and, in addition, there is a new chapter on the use of Chebyshev series. The chapter on the solution of hyperbolic partial differential equations is taken over from the first edition and it contains an account of the theory of characteristics with reference to their use in numerical work. The presence of this chapter is fully justified by the fact that few books on numerical analysis deal with this subject at all adequately; however, it lacks the practical flavour of the rest of the book and I hope that in future editions the authors will be able to include more material of a practical kind. The next chapter contains a short, but modern, treatment of parabolic equations; a result that I have not seen given elsewhere is the stability condition for a process in which the Runge–Kutta method is used for integration in the time-like direction. Elliptic equations are dealt with briefly, but this is to some extent made up for by the fact that there is a chapter earlier in the book on iterative methods for solving linear equations. The chapter on relaxation methods to be found in the earlier edition has disappeared.

Readers who have followed work at the National Physical Laboratory will not be surprised to find the use of "difference corrections" advocated for use in the solution of elliptic partial differential equations and in the solution of ordinary differential equations with two point boundary conditions. A solution is first obtained in which the finite difference formulae are truncated so as to include only the lowest order differences. This approximate solution is then used to estimate the contribution of the neglected differences and this estimate is introduced as a correction into the calculation of a more accurate solution. The process may be repeated as often as is necessary, and the process is then an iterative one. When the method was first introduced it represented, in my opinion, a distinct advance over conventional desk machine techniques, and I am sure that if the development of digital computers had been delayed it would have secured general adoption. I feel, however, that when a digital computer is used the higher order differences may just as well be taken into account from the beginning; in the linear case, in particular, the simultaneous equations that have then to be solved to give the final solution are little more complex than those that must be solved to obtain the approximate solution. A further point against the use of difference corrections with a digital computer is that the iterative process has first order convergence only, and, unless the corrections are very small, several iterations will be required. The old-fashioned desk machine computer was not so troubled by first order convergence, since he would almost instinctively allow for it by over-correcting.

The book does not claim to be a complete text on numerical analysis, but it does contain a concise treatment of certain topics and contains much information not easily obtainable elsewhere. I recommend it to anyone whose work brings him into contact with numerical analysis. It should also be invaluable for students who are pursuing a regular course or who use it in conjunction with a regular textbook. It has an authentic ring about it, and will bring the reader into touch with the kind of work that is nowadays done in a computing laboratory. However, the subject is marching on, and I hope that the authors will not rest on their laurels, but will let us have a further edition before too long a time has elapsed.

M. V. WILKES

CORRESPONDENCE

Letters from readers are welcomed, and should be addressed to the Editor, The Computer Bulletin, Finsbury Court, Finsbury Pavement, London, E.C.2. The name and address of the writer must be given, but will not be published if requested.

Extensions to Algol

Sir,

I agree wholeheartedly with the comments of Mr. J. B. Pollard in the last edition of the *Bulletin* concerning the limitations of ALGOL 60.

Every praise is due to the originators of ALGOL 60 for providing us with a language suitable for the exact description of algorithms in numerical analysis. It seems a great shame, however, that the opportunity is not being taken, officially by the ALGOL Group, to extend this language to make it a suitable common user language for industry and the universities. In this role a simple method of dealing with complex numbers and matrices, such as that suggested by Mr. Pollard, is essential.

Since April, I have been working on such an extension to ALGOL 60 which satisfies most of Mr. Pollard's requirements and has been written as additional wording to the existing ALGOL 60 report. The first draft of this extension has been distributed to the ALGOL *Bulletin* Group as ALGOL *Bulletin Supplement* No. 12, and also with corrections to the distribution of the Brighton Automatic Programming Information Centre. The final version, which is to be produced in the light of criticisms and suggestions received by the writer, will be published in *The Computer Journal* probably in January 1962. It is hoped, in the interests of standardization, that translator-writers will adopt this extension where possible, and that it will serve as an interim language until some official extensions are introduced by the ALGOL Group.

The basic idea of the ABS12 extension is to introduce two new value types, namely complex and array and thus to permit an identifier representing a complex number or array to be linked in an arithmetic expression by the usual signs $\times$, $+$, $-$, etc. There is no need to introduce a new type matrix as this is covered by the type array which is considered to be an array of numbers together with the dimensions of the array. The elements of an array may themselves be arrays, thus providing "built-in" facilities for partitioned matrices. Another example is a Boolean array of Boolean arrays that provides a representation for a file of coded information.

I also feel that it would be advantageous to users to agree upon a much larger list of standard functions, including Bessel functions and the like, which are in everyday use in many industries. I look with horror at the prospect of every translator having a different name for such functions. Furthermore, it would be desirable to agree upon standard names for input/output routines and also input/output formats, and indeed, although this will be much more difficult, standard hardware representations. In this way we may look forward to the day when a program tape will really be able to be run on any machine without the need for transcription. Such standardisation is attempted in the business field by the COBOL group and I feel that the scientific user is in no less need of standardisation of the machine-oriented aspects of his language.

The standardisation of names could be achieved by some organisation, such as the Brighton APIC, being a clearing house for the registration of names. The names would be submitted to APIC, who would have them approved by two disinterested and well-known workers in the field. A list of registered names would be issued periodically by APIC.

Yours, etc.,

R. W. HOCKNEY

English Electric Co. Ltd.,
Whetstone, Leicester.

Lincoln Laboratory

Sir,

Thank you for printing the favourable review of my book *Digital Computer Fundamentals* in the March 1961 issue of *The Computer Bulletin*. The comments of your reviewer, Mr. P. Taylor, were very pleasing. The sentence "Several references are given for each chapter, but not all are generally available, e.g. Lincoln Laboratory Technical Reports, and so not so useful." which appeared in the review bears further comment, however. Lincoln Laboratory of the Massachusetts Institute of Technology is a non-profit research laboratory which distributes its Technical Reports to interested members of the scientific profession at no charge. The reports have a wide distribution list which includes many universities, laboratories, and Government institutions in the United Kingdom and the reports are also distributed upon personal request, within the limits of supply. The Lincoln Laboratory Technical Reports referred to in my book are therefore readily available to English scientists and engineers.

I believe there is a small typographical error in the review. The phrase "errors in Figs. 6–15" should read "errors in Fig. 6–15" for, as Mr. Taylor noticed, there are errors in Fig. 6–15. (There are no Figures 6, 7, . . ., 15, since each figure is designated by the number of the chapter in which it appears, followed by the relative number of the figure in the chapter.) Thanks to Mr. Taylor the errors in Fig. 6–15 will be corrected in the third printing, which is forthcoming.

Yours, etc.,

THOMAS C. BARTEE

Lincoln Laboratory,
Massachusetts Institute of Technology,
Lexington 73, Massachusetts.

THE SYMPOSIUM ON ELECTRONIC DATA PROCESSING

The Symposium is being held at Olympia concurrently with the Electronic Computer Exhibition. A draft programme and synopses of some papers were published in *The Computer Bulletin* for June (Vol. 5, No. 1). Since then, some amendments and more details of the programme have been announced by the organising committee. A copy of the programme is reproduced below, together with some synopses which were not available for the June issue. Delegates will receive papers in advance of the Symposium, for the sessions which they wish to attend. At each session, the speaker will review the salient points of his paper, and bring it fully up to date. Adequate time will then be available for discussion and for answering the audience's questions.

A new feature of this Symposium is a Brains Trust in Session 5 with a panel of experts who are familiar with all aspects of running Computer Service Bureaux for the small user.

The Symposium brochure and application form were issued with *The Computer Journal* for July (Vol. 4, No. 2): further copies or information may be obtained from the Electronic Computer Exhibition Offices, 64, Cannon Street, London, E.C.4.

Synopses of Papers (*continued from Bulletin* 5/1)

SESSION 3

"Control of Aircraft Loading at Copenhagen Airport," V. Bak.

Some information is given about the reasons which led to the introduction by SAS of an electronic data processing system to record the arrival of passengers for flights and simultaneously ensure that the aircraft are correctly loaded.

Technical advantages especially on the installation side are obtained, and the handling of passengers is speeded up. In the registration and computation many man-hours are saved, and the efficiency of supervision is improved.

Experience of three months of operation is good. Human errors are the most frequent—the technical standard is high.

SESSION 4

"Commercial Planning for an Integrated Oil Company," W. P. Brown.

In an integrated oil company there are a number of opportunities to use computers to obtain economic information of the highest value for management guidance. Economic problems involving large amounts of data can be solved and the effect of hypothetical changes to certain factors in the problem can be evaluated swiftly. This considerably facilitates planning work as the economic effect of different courses of action can be machine-calculated as required.

Illustrations are given of the types of situation where such methods are being investigated and applied in oil company planning today.

SESSION 5

"Structural Stress Calculations," C. P. Wroth.

G. Maunsell and Partners are general consultant engineers who have done a considerable amount of work in pre-stressed concrete bridge design in which the speaker is engaged.

At first sight computers do not appear to be a great help as most problems of one-off, and calculations to within 10% accuracy have been considered sufficient. The one-off problem has been overcome by the use of autocode.

The great advantages of using a computer are that it is possible to use different methods of analysis which were previously not practicable owing to the length of time they took and also that the computer works at high speed and is reliable. As an example, a problem which would take a designer two weeks to work out can now be put on an autocode system in half a day and takes 3 to 4 minutes of computer time, thus effecting a saving in cost.

WEDNESDAY 4 OCTOBER 1961

1958–1961—A RECORD OF PROGRESS

Session 1

OPENING ADDRESS—DETAILS TO BE ANNOUNCED

MORNING 10.15 a.m.–12.30 p.m.
CHAIRMAN—SIR JOHN SIMPSON, C.B.—Controller, H.M.S.O.

- **"Progress in the Introduction of Automatic Data Processing in Government Departments"** — J. D. Janes—H.M. Treasury
- **"Production Control Scheme for Letchworth Factory"** — J. Grant—International Computers & Tabulators Ltd.
- **"Inventory Control, Accounting and Payroll"** — A. Bradley—Ford Motor Co. Ltd.

Session 2

AFTERNOON 2.30 p.m.–4.45 p.m.
CHAIRMAN—B. A. MAYNARD, British Institute of Management

"Establishing Electronic Data Processing at the Trygg-Fylgia Insurance Companies—Stockholm" ● K-E. SCHANG—Trygg-Fylgia Insurance Co.'s Group, Sweden
"3½ years practical experience" ● N. C. POLLOCK—Stewarts & Lloyds Ltd.
"Invoicing" ● A. J. BROCKBANK—Glaxo Laboratories Ltd.
"Production Control by Hiring Computer Time" ● R. B. BAGGETT—Job White & Sons Ltd.

THURSDAY 5 OCTOBER 1961

DATA PROCESSING IN INDUSTRY AND COMMERCE

Session 3

MORNING 10.15 a.m.–12.30 p.m.
CHAIRMAN—THE EARL OF COURTOWN—President, Institute of Office Management

"Provisioning 1300 Shops" ● D. S. GREENSMITH—Boots Pure Drug Co. Ltd.
"Data Processing in Commerce" ● L. G. BONNEY—Crosse & Blackwell Ltd.
"Use of a Computer in Banking" ● J. LETHAM—The Bank of Scotland
"Using a Computer for Insurance Work" ● F. C. KNIGHT—Commercial Union Assurance Co. Ltd.
"Control of Aircraft Loading at Copenhagen Airport" ● V. BAK—Scandinavian Air Systems

Session 4

AFTERNOON 2.30 p.m.–4.45 p.m.
CHAIRMAN—L. W. BAILEY, Institute of Production Engineers

"An approach to Integrated Production Control" ● W. J. KEASE—A.E.I.—Hotpoint Ltd.
"Commercial Planning for an Integrated Oil Company" ● W. P. BROWN—Shell International Petroleum Co. Ltd.
"Recording and Controlling Production Stocks" ● D. O. BELL—Standard-Triumph International Ltd.
"Finished Stock Control, Production Monitoring, Sales, Statistics, etc." ● F. STUBBS—A.E.I. Ltd.
"Production Planning" ● J. ANTILL—Rubery, Owen & Co. Ltd.

FRIDAY 6 OCTOBER 1961

BUYING TIME

Pointing the way for the smaller user

Session 5

MORNING 10.15 a.m.–12.30 p.m.
CHAIRMAN—D. W. HOOPER, The British Computer Society

"Survey of the Computer Bureaux Service" ● D. W. HOOPER—The British Computer Society
"Structural Stress Calculations" ● DR. C. P. WROTH—G. Maunsell and Partners
"Costing Oil Drilling Operations" ● G. DE VERTEUIL—Schlumberger Overseas S.A.
"Planned Stock Control" ● C. H. BAYLISS—The Ever Ready Co. (Great Britain) Ltd.
"Keeping an Inventory of Precious Metals" ● S. A. EMERY—Engelhard Industries Ltd.
"Evaluation of Confidential Materials" ● A. J. STEVENSON—Stevenson & Howell Ltd.
"A Market Survey" ● H. WORMALD—Midlands Electricity Board

BRAINS TRUST—Chairman—D. W. HOOPER—The British Computer Society. *Remaining members to be selected*

NEW TECHNIQUES

Session 6

AFTERNOON 2.30 p.m.–4.45 p.m.
CHAIRMAN—CYRIL PLANT, Trades Union Congress

"The Place of the Programmer" ● DR. S. GILL—Ferranti Ltd.
"Character Recognition" ● DR. M. B. CLOWES, J. R. PARKS—National Physical Laboratory
"New Equipment" ● DR. A. S. DOUGLAS—C.E.I.R. (U.K.) Ltd.

A PREVIEW OF PART OF THE ELECTRONIC COMPUTER EXHIBITION, OCTOBER 1961

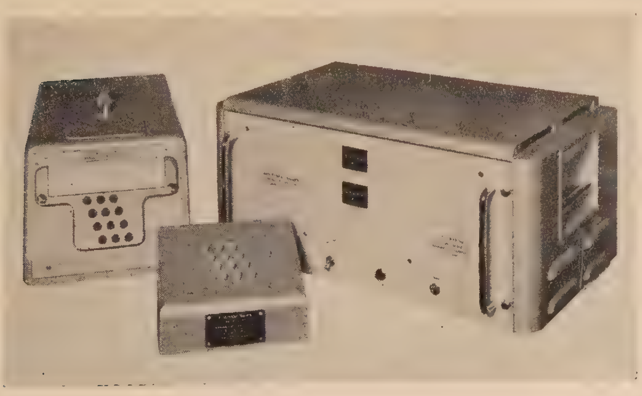
Compiled by an Associate Editor from notices received

The article "New-Generation Computer Exhibition" on page 47 of *The Computer Bulletin*, June 1961, concluded with an invitation to Exhibitors to send in details of planned and expected exhibits by the end of July. Reminders were sent to all exhibitors of equipment on 22 July, and by 28 July 30 had responded, when this issue of *The Computer Bulletin* had to go to press. We regret that the incidence of printers' and editorial holidays made it impossible to accept material received after 28 July. All our regular advertisers will be exhibiting and our readers will know the type of equipment which they may expect to find on these stands. It is also clear that some Exhibitors will have new equipment or surprises to announce when the Exhibition opens.

Our readers who are interested in logical design and computer building will be able to compare the constructional and design details of the equipments on the different stands: equipment of British, Canadian, American, French, Swedish and Italian origin will be on show, and also equipment from other countries.

The scientific user will have much analogue and digital input/output equipment to see.

Chartered Accountants, Secretaries and Procedures Managers will wish to spend some time with the tabulating and other office machinery in the concurrent BEE, in an adjoining hall. They will see here that more computer-equipment is beginning to look like office-machinery. At one end, paper-tape editing equipment mounted on a specially designed desk, which conceals the transformer and multiple connections, with a few simple push-button controls, becomes a more acceptable input medium to a junior school leaver aged 16. In the middle, the advent of business auto-codes and supersession of the cathode-ray tube display by a monitoring typewriter, will make it easier to train existing office staff, whose jobs are being taken over, in computer programming and operation. At the output end, the availability of electric-typewriters, with business-like keyboards and elite type, responding to British Standard and other paper-tape codes, makes it feasible to produce for top management their finished statements and statistical tables, automatically from the computer. There will be much improvement for the business user to see, compared with 1958. *Data-transmission* will also be demonstrated on several stands.



The Solartron Automatic Keyboard Instructor (SAKI).

An appreciation and review of the Exhibition and Business Symposium will be given to the Society by two members of the Editorial Board after the event, and it is hoped to publish this in our next issue. The promised revision of the table of exhibits and stand space is deferred until then, as we were unable to complete the revision before this issue went to press from the limited data-input received.

We regret that some of the biggest Exhibitors were not able to send us advance notice of their intentions. The sample includes a few Exhibitors whose equipment has not previously received much attention in these columns; and there is plenty of ancillary equipment, which may often be *the key* to a successful application. We hope that visitors will allow adequate time to appreciate the detail of the show.

Stand 1. The Solartron Electronic Group Ltd.

(*a*) *SAKI*

The Solartron Automatic Keyboard Instructor uses cybernetic principles in the training of punched-card operators, providing progressive instruction leading the pupil to speed and accuracy. Use of the equipment can reduce training devoted to the fundamental skill of accurate keyboard operation, release punching equipment for productive work, eliminate the use of cards in training, and is a guide to the pupil's aptitude for the work, enabling the unsuitable to be transferred before much time and money have been spent on training. Supervision of trainees is simplified through the automatic impartial machine record of pupil performance, and the pupil's interest is maintained by the challenge offered in the exercises. The equipment can be used for new trainees, and for refresher training, also rating assessments of skilled operators. Faulty habits of operation are discouraged, and sustained concentration necessary for good productive work is instilled. At all stages of training the machine encourages high standards of performance, keeping ahead of the pupil, noting her weaknesses and taking account of her errors. The unit is at present in use in a number of punched-card installations and is available for twelve-key keyboards and full alpha-numeric (I.C.T. and IBM) keyboards.

(*b*) *Minimal Computer*

A small digital computer suitable for a wide variety of special purpose scientific, technological, and business applications. It is a solid state device combining high-speed with operational flexibility.

(*c*) *Analogue Computer Systems S.C.D.* 24

New design techniques have enabled a range of inexpensive analogue computer modules to be produced, the basic brick being the twin operational amplifier AA. 1054, a high gain drift-corrected D.C. amplifier. These modules have been incorporated in this new computer system S.C.D. 24, and

this produces a comprehensive, but inexpensive, expandable machine in the range of 24 to 168 amplifiers.

(*d*) *Analogue Computer S.C.D.* 10

A 20 amplifier computer, designed for high performance at low cost. It can be used in the fields where complex non-linear systems require investigation with the minimum capital expenditure. This computer is a development of the successful "Minispace" Computer and is particularly suitable for Laboratories, Universities and Technical Colleges.

(*e*) *Analogue Computer S.C.* 30

A very successful high precision 30 amplifier computer in the medium price range. It combines high accuracy with comprehensive control and programming facilities and outstanding overall flexibility. It will provide accurate solutions for a wide range of linear and non-linear dynamic problems.

Stand 2. EMI Electronics Ltd.

An EMIDEC 1100 transistor computer, of the type already installed in the offices of nine leading industrial organisations and government departments in the United Kingdom, will be shown working on EMI Electronics Ltd.'s Stand.

This will be the first time that an EMIDEC 1100 has been shown in full operation at a public exhibition. A popular feature of the EMI stand is expected to be the private theatre where frequent showings will be given of "Computer Achievements," the new 22-minute colour film which describes the work of the EMIDEC computers at Boots, British Motor Corporation, British European Airways, Barclays Bank and the RAOC.

Among the computer programs which will be demonstrated regularly on EMIDEC throughout the exhibition, are part of the payroll at B.M.C.'s Longbridge factory, stock control at the Admiralty stores at Copenacre, sales invoicing for EMI records, and typical hire service applications, such as fixed interest yield tables and engineering calculations.

Installation will include a four-bay computing unit containing a 16,000-word drum, control console, power supply, four operational magnetic tape decks and a spare deck, 5-hole paper tape punch and teleprinter, paper tape reader, card punch, card reader and 600-line-per-minute printer.

Punched tape and cards for most programs will be prepared in advance, but a small data preparation area will enable some data to be prepared on the stand. Also connected with the computer area will be a job assembly area, a maintenance area and a magnetic tape library. Visitors will therefore be able to see a complete data processing system operating in a typical layout. Systems analysts, programmers, installation and commissioning engineers will be in attendance to explain the comprehensive service given by EMI both before and after installation of an EMIDEC.

It usually takes five to six weeks to commission an EMIDEC computer on a customer's premises, with a further week for acceptance tests. EMI engineers will be allotted five or six days at Olympia to install the computer and make it fully operational.

Normally a computer site is air-conditioned, but this is not possible at the exhibition so a compromise will be made. It is intended to install a cooling and filtering plant—a small version of that usually installed on a site—which will provide filtered and cooled air to the EMIDEC computing unit, the tape decks and power unit. This plant will be supplied by Denco Miller Ltd.

Automatic Telephone and Equipment Ltd. will provide a high-speed data link between the ATE and EMI stands. The equipment will include 5-hole paper tape input and output, with automatic error detection and correction.

Stand 4. Addo Ltd.

The exhibits on the stand of the Automatic Data Processing Division of Addo Limited will show how Addo-X adding/listing and book-keeping machines may be used as peripheral equipment in data processing systems:

(*a*) *Tape Punching*

A shuttle carriage machine will be linked to a tape punch, producing tape for computer input during a three-column listing operation. Batch control totals are available for checking, and parity and format checks can be incorporated on the punch, thus providing a "hi-fi" tape without the need to verify the punching in a second operation.

(*b*) *Card Punching*

An Addo-X 7000 class book-keeping machine will be linked to a card punch, producing tabulating cards for analysis, during a ledger-posting operation. This demonstration will also show a method of proof of correct ledger card selection.

(*c*) *Card Reading*

An Addo-X book-keeping machine linked to an IBM Card Punch, modified as a card reader, will demonstrate how tabulating cards may be used for conventional ledger posting on the Addo-X. The principle may also be applied for punched-tape reading in a variety of applications, including off-line printing.

(*d*) *Data Collection*

A number of Addo-X shuttle-carriage machines, linked to an Addo-X 7000 class machine and a card punch, will demonstrate a simple data collection system for centralised control of stores, and preparation of input data for the data-processing system.

(*e*) *Data Logging*

An Addo-X 6000 class machine linked to an Addo Tape Reader will demonstrate how the machine can be used as a data logger, or for off-line printing.

(*f*) *Strip Printers*

This demonstration will indicate the uses of the electrical input Addo-X machines for recording output from a variety of metering devices.

Addo Ltd. Automatic Data Processing Division was formerly part of Bulmers (Calculators) Ltd.

Stand 5. Block and Anderson Ltd.

(*a*) *Bandatronic*

The Bandatronic multiplies in sterling, types out the result, rounding-off to the nearest penny if desired. It calculates discounts, adds amounts typed in black, subtracts amounts typed in red, stores and automatically types out sub-totals and totals, and accumulates a grand-total of the day's operations.

A unique feature of the Bandatronic is that it calculates in sterling for as many as six input/output typewriters, and because of the extraordinary speed of operation, there is no delay in the automatic typing out of the results. Each input/

output typewriter may be used on a different program, and the extreme flexibility of the equipment allows immediate change to take care of peak loads on any particular program. Punched paper tape may be produced as a by-product of typing the original document for tape-to-card conversion, or input to computers, and tape readers can be fitted to operate the typewriters automatically, when reproducing repetitive data.

(*b*) *Typetronic* 2215

Block and Anderson are also featuring the Typetronic 2215, a business-document writing system consisting of an electric typewriter, with electronic components, which can be programmed for any automatic typing operation.

Activated by edge-punched cards or punched tape, the Typetronic will automatically type at more than 100 words per minute, eliminating human error and costly manual repetitive writing. The fact that the machine itself produces edge-punched cards or punched tape for future automatic processing, and makes its own feed holes, represents a significant saving in time and money.

Variable data can be entered on the typewriter by the operator. The typewriter stops automatically at the correct location for entry. Selected entries can be punched into new punched tape or edge-punched cards.

Besides speed and accuracy, a notable feature of the Typetronic 2215 is its silent operation. Direct or remote controls enable the operator easily to command the entire system, to alter it without switching off, and to change programs. A safety device eliminates errors due to incorrect mode or punch set-up by automatically stopping the operation when any error in reproducing is detected.

Stand 6. Standard Telephones and Cables Ltd.

A typical Stantec Computing System will be exhibited on the STC Stand. The range of Stantec Computing Systems is based on a compact, low cost, transistorised computer with a storage capacity of 8,192 words. This is a self-contained computer costing under £30,000, the programming philosophy of which is similar to the established Stantec Zebra machine. From a basic machine, several different types of computing or data processing systems may be built up by the addition of the necessary input/output and storage equipment. The main store is a magnetic drum, backed by ferrites and/or magnetic tape.

A working demonstration of one of the range of data transmission systems to be supplied by STC will be given. It will consist of sending and receiving terminals which will be linked over GPO lines to a Stantec Zebra Computer at Harlow, Essex. Programs and data will be fed to the computer and the answers printed out on the stand.

To illustrate the activities of STC and its associate companies in the field of airline seat reservation, a seat sales desk will be set up on the STC stand, at which visitors will be able to interrogate the magnetic drum store of the Scandinavian Airlines System (SAS) in Copenhagen. The SAS Electronic "Availability" system was supplied by Standard Elektrik Lorenz; a similar system is being supplied by STC to the British Overseas Airways Corporation.

Displays giving details of equipment for the automatic computation of aircraft loading and balance figures will also be on show. The first system of this kind was installed by STC and its German Associate Company, SEL, for SAS in Copenhagen.

Stand 7. Honeywell Controls Ltd.

(*a*) Full details will be released on the Honeywell 800 and 400 Computers.

The 800 system is a medium-to-large scale system of considerable versatility and performance, for both business and scientific applications. Some of the outstanding features are: an excellent library of automatic programs; automatically controlled multi-program processing; compatability with other systems; on-line enquiry and communication processing. It is a fully developed system, used quite extensively in the U.S.A.

The Honeywell 400 system is a medium scale, large-performance system. It utilises the same peripheral equipment and has complete compatability with the "800."

(*b*) In addition, they will be displaying a magnetic-tape Unit from the associate company Magnetic Products Ltd. The primary application of this unit is as peripheral equipment for computers, input or output or off-line conversions. Its function is to record data from the computer, or feed the data from the magnetic tape on to paper tape or printer. Conversely, it can convert information from the paper tape or printer on to magnetic tape. All these functions are achieved by one machine. For this display, the tape unit will be driven by a digital accumulator unit from the Honeywell Special Systems Division, who will also be showing an Optimising Analogue Computer.

Stand 8. Ferranti Ltd.

It is expected that Ferranti exhibits will be based on the following items of hardware:

Argus process-control computer. Sirius general purpose computer. Moiré-fringe digital measuring equipment. Orion components. Atlas components. Ferranti-Packard Document Transcriber and Data Originator. Ferranti-Packard Table Look-Up machine. Ferranti-Packard Modular Displays.

Demonstrations will show the use of Argus for plant control and the use of Sirius and the Ferranti-Packard Document Transcriber and Data Originator as a data processing system controlling distribution.

Stand 9. The English Electric Company Ltd.

The English Electric display is intended to cover the full range of their data processing equipment and services.

The KDP 10 is a medium-to-large data processing system particularly designed for working with large files of data. The KDF 9 is a very high speed general purpose computer system. These two have a common range of peripheral equipment, which can also be made up into a variety of off-line transcribers. They will be represented on the stand by a card-to-magnetic-tape transcriber and an off-line magnetic-tape printer. There will also be specimen racks and packages, and pictorial displays.

A complete KDN 2 will be working on the stand; this is a new small-scale general purpose computer, intended for industrial and commercial applications and for auxiliary operations with the larger systems.

The range of special purpose industrial data processing equipment made up from DATAPAC standard packages will be represented by a working data logging system.

The very well-known DEUCE computer and the LACE analogue computer, which were displayed at the 1958 Exhibition, will be represented by pictorial displays.

There will also be a working data transmission terminal and one or two other peripheral units.

The extensive user-service and liaison organisation will be represented by program library and other literature and by specialist staff who will be available for consultation on all types of application.

Stand 10. Friden Ltd.

(*a*) *Collectadata*

Friden Ltd. will be showing this new range of equipment designed to facilitate the collection of data from any number of points of origin to a data processing centre. The system consists of two basic units, a transmitter and a receiver. Two transmitters are offered, of which one takes punched tape or edge-punched cards and the other tabulating cards. Any number of transmitters can be attached to one receiver and to ensure a free flow of information from each transmitter in turn a "Line Busy" indicator is fitted. This will then hold transmissions until the line is cleared.

Among other important points incorporated in the Collectadata system is the ability to set up to 18 digits of variable data on the dials. Eight digits of this data are read out at the beginning of the transmission and the remaining 10 digits are read out and transmitted when a transfer code is read. Another is a parity check whereby each code is checked as it is punched. If an error occurs, an error light glows on the transmitter. The operator must then re-transmit the whole message. A "Time-Code" emitter may be attached to the Receiver. This records in the tape, the time each transmission took place.

The system has many applications in industry, one of the most important being production control. This application is being demonstrated using two tabulating cards as input. The first has the employee details and the second the job details.

(*b*) *Friden Punched Tape Code Converter*

The Friden Punched Tape Code Converter will be shown for the first time. The equipment consists of a paper tape reader and a punch housed in a single unit, and capable of converting any 5, 6, 7 or 8 track code into any other 5, 6, 7 or 8 track code. When converting to 5 track code, the figure and letter shift codes are added automatically to the output tape. A special feature is available to enable the line feed code to be inserted when converting to 5 track telegraphic code. Another special feature permits portions of the tape being read to be skipped under control of codes in the tape. The speed of the Code Converter is 1,180 codes per minute.

(*c*) *Flexowriters*

The stand will also feature Flexowriters being used for data preparation in the insurance industry and for use with the many computers now available in this country.

Stand 11. IBM United Kingdom Ltd.

The following equipment is expected to be among that shown on the stand of IBM United Kingdom Limited:

(*a*) *IBM* 1620 *Data Processing System*

An easy to use stored program computer which packs great power into small space. Contains up to 60,000 positions of magnetic-core storage. The system is suitable with off-line listing of output cards, for many commercial applications, although it is intended primarily for scientific and engineering work. Input and output is alpha-numeric on punched cards, typewriter and punched tape. It will be demonstrating scientific and engineering applications.

(*b*) *IBM* 1401 *RAMAC Data Processing System with high-speed tape units*

A transistorised stored program computer with a wide range of configurations for commercial and scientific applications. Up to 16,000 positions of core storage and a maximum of 6 high-speed magnetic tape units. This RAMAC disc storage unit will have a capacity of 20 million characters of information, immediately accessible in random order. (*See p.* 94.)

(*c*) *IBM* 1001 *Data Transmission System*

Consists of one or more sending stations linked to a central receiving station by dial telephone lines. The sending station includes a telephone, a terminal containing a card reader and keyboard and a modulating subset. The central receiving station consists of a telephone, IBM card punch modified with a data translator and a demodulating subset.

Data is read and transmitted at 12 card columns per second with automatic data checking. This equipment will be demonstrating a stock control application.

Stand 14. The National Cash Register Company Ltd., *in conjunction with* **Elliott Brothers (London) Ltd.**

(*a*) One of the main features of this stand will be a representational display of the new N.C.R. 315 electronic data processing system, expressly designed for business use and now being built in Britain. It employs a unique memory system called CRAM, which stores information on special magnetic cards and provides exceptional facilities for both random-access and sequential processing.

The cards are held in interchangeable cartridges, each of which stores over five million alpha-numeric characters. Since a cartridge can be changed in less than 30 seconds, the total capacity of this flexible magnetic filing system is virtually unlimited. For many purposes, one CRAM unit will do the work of three or four conventional magnetic-tape units. However, in larger installations up to 16 CRAM units can be coupled simultaneously to the 315 central processor, giving immediate access to any one of 88 million alpha-numeric characters.

(*b*) For the mass production of invoices, statements and other business documents there will be shown a *high-speed printer* working at 680 lines per minute (or 900 lines per minute on purely numeric information). This is based on equipment which has already been installed by British firms and has established its ability to sustain these speeds over very long periods.

Arrange to meet your friends and introduce new members at Stand 50, The British Computer Society

(*c*) *New Card Reader—Fastest Yet*

The many peripheral units specifically designed for use in the 315 system include the N.C.R. C-380 high-speed punched-card reader. This reads and checks up to 2,000 80-column cards per minute—a new experience in the field of punched-card processing. The reading is done electronically. Automatic checking features include the use of dual-reading stations and parity check after decoding. The hopper holds up to 5,000 cards.

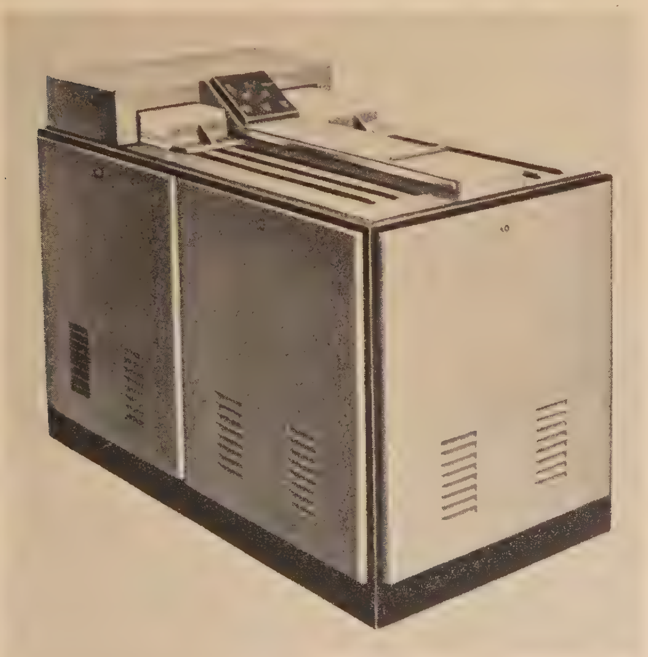
The new card reader will be seen in action for the first time at the Exhibition.

(*d*) *Versatile Data Processing System*

An entirely new business data processing system—the N.C.R. 390—will make its first public appearance at the Exhibition. Compact and inexpensive, it has been designed for general-purpose work in firms of all types and sizes. The 390 employs special magnetic ledger cards, on which information is recorded in both normal print and "machine language." Whenever one of these cards is extracted from a file and placed in the printer, a complete history of the account is immediately passed to the central processor.

The built-in "memory" consists of a series of narrow magnetic strips, superimposed on the back of the card. These can be likened to sections of the magnetic tape used in large computers. Up to 200 characters of information can be stored on each card. The encoded information is automatically read and verified at high speed. Whenever the account is processed, the 390 updates both the printed and magnetic data on the card.

The complete system consists of central processor, console and various input, output and memory units. The processor is transistorised and has a magnetic-core memory for storing program instructions, accumulated totals and other data. Every mechanical and electronic function of the equipment is automatically controlled by the internally-stored program. This, however, can be varied at will by the monitor, who has random access to the memory units.



The new N.C.R. high-speed punched-card Reader.

Information is fed into the N.C.R. 390 in four ways—by direct entry on the console's keyboard, by punched paper tape, by punched cards, and by the magnetically-encoded ledger cards. All of these input methods can be used simultaneously. Multi-form business records and accounting summaries are produced immediately in conventional print. Other output methods include punched paper tape, punched cards and magnetic encoding.

(*e*) *Magnetic Files for* 803 *Computer*

The latest version of the cabinet-sized National-Elliott 803 computer will make its first public appearance at the Exhibition. Its new features include much increased magnetic-core storage facilities—up to 8,192 words.

N.C.R. will be demonstrating a complete 803 business data processing system equipped with large-volume magnetic files. These files, also on show for the first time, use magnetic film of the type which has been operationally proved in the extensive range of National-Elliott 405 installations. The 803 is claimed to be the cheapest and most compact business computer to offer storage facilities of this kind. The applications to be demonstrated at the Exhibition include sales analysis, stock control, and cost allocation.

(*f*) *Automatic Data Capturing*

The input tapes for many of the computer demonstrations will be produced by automatic punches coupled to National cash registers, adding machines and accounting machines. This equipment will be situated on the company's stands at the Electronic Computer Exhibition and the concurrent Business Efficiency Exhibition. The advantage of preparing input tapes in this way is that information required for analysis or other forms of processing is automatically "captured" as a by-product of routine book-keeping operations which themselves provide printed records for immediate reference and action. Moreover, the information is verified by normal accounting checks before it is fed into the computer for processing.

(*g*) *Inexpensive Service Work*

Other demonstrations will illustrate the variety of work which is now being handled by the N.C.R. Electronic Data Processing Centre at Marylebone Road, soon to be augmented by a second centre in the City of London. In many cases the centre processes punched paper tape produced by clients on National equipment.

(*h*) *Elliott Brothers* (*London*) *Ltd.*

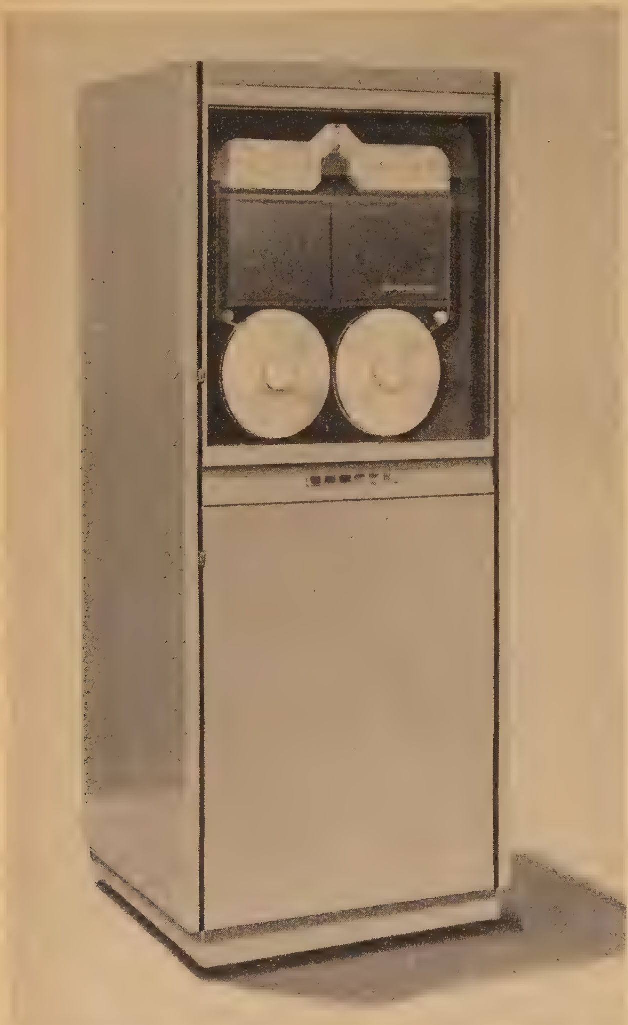
N.C.R. are sharing a stand—covering over 3,000 square feet—with Elliott Brothers (London) Ltd., with whom they collaborate in the installation of electronic data processing systems.

Elliotts, in conjunction with Panellit Ltd. (another member of the Elliott-Automation Group) will be demonstrating a wide range of equipment and applications concerned with scientific and mathematical computing, and with the automatic control of industrial processes. Readers who remember this equipment at the 1958 Exhibition will wish to visit the stand for full details to bring their knowledge up-to-date.

Stand 17. Decca Radar Ltd.

This Company expects to exhibit the latest British computer magnetic-tape transport Type 4000, manufactured by them. This new unit, which can be employed with any digital computer, is claimed to be the most advanced com-

puter tape unit available in the world. The Type 4000 has been designed for operation with the new generation of high-speed computers now coming into service in the industrial, technical and scientific field. It follows the Decca 3000 twin tape unit which is firmly established as the leading European equipment of its type, and of which many have been installed in the United Kingdom.



New Decca Type 4000 *Tape Unit.*

Features of the new Decca equipment are complete absence of computer program restrictions, quietness in operation, the provision of automatic loading and unloading routines, simplicity in design and operation, and the absence of maintenance adjustments. Wide margins of performance and continuous rating of components are characteristics of the design, ensuring reliability, serviceability and freedom from scheduled or unscheduled maintenance.

Two versions of the unit with similar electrical and mechanical parameters will be available for handling 1 inch and ½ inch magnetic tape. The standard cabinet contains one tape transport, electronic circuits, manual control panel with logical interlocks, head amplifier circuits, and power and vacuum supplies.

Less than 2 milliseconds is required from the receipt of the start signal until the tape is running and remains running at the specified speed in correct registration with the head. At a tape speed of 150 inches per second the length of tape lost from use during starting and stopping is less than 0·3 inch. Dual write/read heads are available at 0·39 inch spacing in order to provide for immediate check-back of recorded information. When this system is used a typical inter-block gap is only about 0·7 inch giving improved tape utilisation. Standard data rates are 45,000, 90,000 and 180,000 characters per second. The latter is achieved by an interlaced track arrangement which also leads to a very high efficiency in the usage of tape by allowing the recording of twice as much data on a reel as compared with conventional methods.

The type 4000 design incorporates pneumatic drive of the tape, a technique pioneered in the Decca 3000, and which is now being followed throughout the world. This technique permits rapid but smooth accelerations and decelerations to be achieved yet maintaining correct registration of the tape with the head. The new unit also employs large capacity bins as tape reservoirs giving ample time for smooth acceleration of the tape reel. The tape content of these reservoirs is automatically maintained between the necessary limits by a servo system employing an induction motor and saturable reactors. The tape unit is of course fully transistorised.

The advances made in the reliability of electronic computers over the last few years have set very high demands on the reliability of computer peripheral equipment, at the same time as the increasing requirements for higher performance. The demand for lower levels of maintenance becomes even more important as the number of peripheral units on computers increases. Decca claim that the intensive development and design work embodied in the Type 4000 will lead to higher utilisation of basic computer time by reducing the time formerly lost in servicing, and in restarting a program after a breakdown.

Stand 18. Electronic Associates Ltd.

The centrepiece of this Stand will be a PACE 231R, high-accuracy analogue computer. This computer will have associated with it the new high-speed repetitive operation facility, similar to that recently installed at the Atomic Weapons Research Establishment at Aldermaston. Details of this facility are given in a brochure available from the Company (ref. AC. 6034).

In addition to this main exhibit, there will also be the unique transistorised TR-10 computer; the 1100E X-Y Plotter; the Series 3100 Dataplotter, which can be operated from punched cards, punched paper tape or a manual keyboard; the 26.070–1 Digital Voltmeter (and also possibly the Series 5000 Digital Voltmeter); the 1902D 8-Channel Recorder, and several of the wide range of computing units from their TR-10 and 231R computer systems.

Publications on all the above equipment are available from EAL. Electronic Associates claim to be responsible for more than 80% of all the general purpose analogue computing installations throughout the Western World.

Such is the enthusiasm amongst present and potential UK customers of PACE computing systems that they have proposed the formation of a UK Simulation Council, composed of PACE users, with the aim of regular discussion on computer applications, the advancement of programming techniques and eventually the pooling and loan of specialised units from the extremely wide range of PACE equipment. This UK Council was proposed by Mr. D. A. Eyeions (engineer in

charge G.E.C. Erith installation) and follows closely the well established S.A.M.S. council operating amongst the many PACE users in Scandinavia. It should be stressed, however, that Electronic Associates has no financial connection with these organisations, although naturally they will offer any assistance, if called upon to do so.

The future programme of development by Electronic Associates include extensive use of digital techniques and the more general use of transistor circuitry in larger computing systems.

Stand 19. Automatic Telephone and Electric Co. Ltd.

(*a*) The principal A.T.E. exhibit will be a display of high-speed punched-tape input and output data transmission systems for operation over normal telephone circuits. Three transmitting terminals will be shown working through an automatic telephone exchange to the respective receiving terminals located on the stands of three computer manufacturers; 5, 7 and 8 unit codes will be transmitted. These systems are engineered to meet the specific requirements of users in respect of the 5-, 6-, 7- or 8-unit code to be transmitted, the type of line or radio circuit over which the equipment has to operate, the error rates which can be tolerated by the user, and the type of modulation and the transmission speed. Alternative methods of modulation and transmission speeds of 750, 1,500 and 2,400 c/s are available.

(*b*) Low-speed data equipment, operating at the normal telegraph transmission speeds between 45·5 and 100 bauds, will be exhibited as follows:

The regenerative repeater TRR 2A, which regenerates start-stop signals of 7- to 10-unit codes having up to 48% distortion.

The TDMS 5 BV and TDMS 6 BV which, together with the telegraph signal display unit TDU 2, provide a comprehensive range of test facilities for maintenance of telegraph equipment and systems.

The tape reading autonumber sender TAA 6. This will handle any 5-unit business machine or computer code and is suitable for operation at normal telegraph transmission speeds. In addition to reading punched tapes, the equipment will generate, automatically, certain preset instructions or functions.

(*c*) A.T.E. will also be exhibiting magnetic drums and other computer devices for use in automatic telephone routing, switching and metering.

Stand 22. British Olivetti Limited

This Company will demonstrate an integrated low-cost and simple data preparation system, which will include the following items:

Audit Telebanda accounting machines with numerical and alpha-numerical printing and six-channel alpha-numerical paper-tape punching;

Audit 930 typewriter with paper-tape punching;

CBS 400 and *CBS* 120 photoelectric tape-to-card converters, with ferrite-core memories and checked reading;

CBN photoelectric paper-tape to magnetic-tape converter, with basic editing facilities.

Stand 23. Original Document Processing Ltd.

This Company is the Representative in the United Kingdom of Cummins-Chicago Corporation. It will be showing, for the first time in London, a range of *PERF-O-DATA* Equipment which will include:

(*a*) *Several PERF-O-PUNCHES*

These machines perforate up to 15 digits into coupon-books, or payment slips for use by hire-purchase customers or equipment renters. A slip is sent in with each payment and the perforated codes can be read by the Perf-O-Reader. The system is also suitable for insurance premium collection. It provides a cheaper alternative to magnetic ink for certain applications.

(*b*) *The PERF-O-READER*

When the payment slips are received back with the payments they are inserted in a Perf-O-Reader which will automatically read the perforated data providing an output which will operate a paper tape or card punch. The speed of reading is limited solely by the speed of the inter-connected punch. An automatic listing can be obtained through a tape reader linked to an add lister.

The Perf-O-Reader on show will be linked to a Creed Model 25 tape punch. The tape will be read by a Friden tape reader into an Underwood Adding and Listing machine.

(*c*) *A PERF-O-SORTER*

This can be used to sort coupons into account number order at a speed up to 550 per minute, depending upon the length of the document.

They will also be exhibiting the *Carditioner* whose purpose is to recondition bent and crumpled punched cards. It also automatically segregates those cards to which staples or other foreign matter have been attached. It allows the use of punched cards in applications which previously were impracticable because of the problem of mutilation.

Stand 24. Rank Precision Industries Ltd.

The first production model of the *Xeronic*, the fastest and most versatile business computer output printer in the world, has been completed and will be used with an EMIDEC 2400 Electronic Computer which is to be delivered to the Ministry of Pensions and National Insurance in Newcastle later this year.

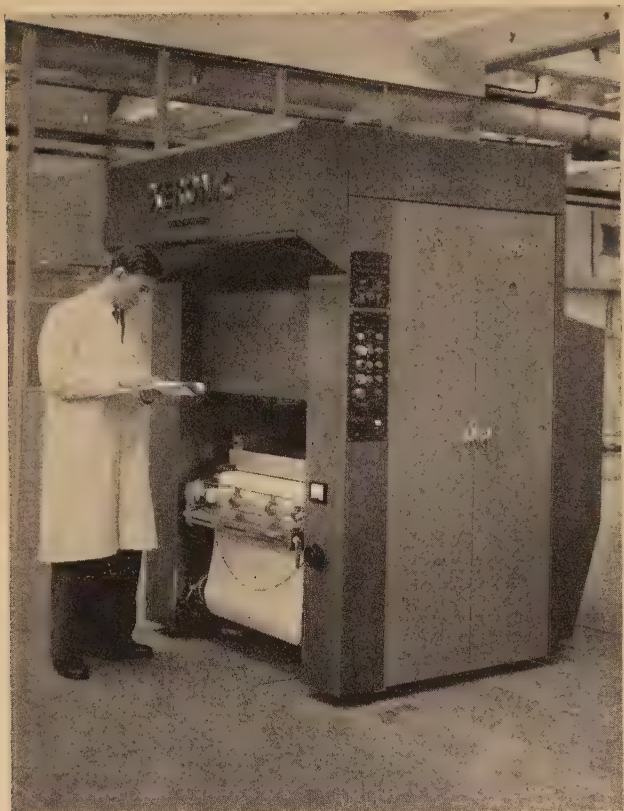
Xeronic printers will be fully demonstrated in public for the first time on this Stand and on the Stand of AEI (15). An experimental prototype was shown in 1958.

The Xeronic prints information from a computer on to plain paper at the rate of 4,700 characters per second. This speed is comparable, for instance, to reproducing the contents of the Bible in about 15 minutes. Simultaneously, it prints its own forms to contain the information, from a selection of four different designs. Development is in progress on a new machine that will select from 32 forms. An automatic and comprehensive system of detecting and indicating printing errors is incorporated in all Xeronic machines.

The machine is a complete departure from conventional computer output printing methods. There are no high-speed mechanical parts. Xerography and an electronic method of character generation are used.

Xerography is the unique dry printing process which may be described broadly as "electrical photography." It does not involve the use of chemicals or specially treated paper. The signals from the computer are written by a beam of electrons on to a cathode ray tube screen. This visual image is then copied by xerography on to a continuously moving roll of paper.

Of the machines which will be delivered in 1961, one will go to Ferranti for use with a Ferranti Orion computer at that Company's London data processing centre; the second will



The New Xeronic Printer (*Stand No.* 24).

go to A.E.I. Ltd. to work with an AEI 1010 Computer in the R.A.F. Central Accounting Unit at Hendon; the third will go to the Commercial Union Assurance Co. Ltd. for use with an English Electric KDP 10 Computer at the new Data Processing Centre in Exeter.

Cost of a Xeronic installation to the user is between £60,000 and £100,000, according to the specification required.

Stand 25. De La Rue Bull Machines Ltd.

De La Rue Bull Machines will be exhibiting the following machines:

(*a*) 300 *Series*
Program Unit. Card Reader. Card Reader/Punch. Printer. Electric Calculator. Gamma 300 with Magnetic Drum.

(*b*) *Conventional Punched-Card Machines*
Punch. Verifier. Posting Interpreter. D3 Sorter. 535 Tabulator with Summary Punch and IPC Ledger Posting Device. 1931 Tabulator (not working).

(*c*) The 300 D.P. Series of business data processing equipment will be shown for the first time in Britain in computer form. Not intended to displace completely 150-cycle punched-card machines, which still provide the answer to many problems, the 300 D.P. Series provides an opportunity for expansion from electro-mechanical equipment of revolutionary concept to a highly developed electronic system with both drum and tape storage.

The 300 D.P. Series comprises a series of units each of which performs a prime processing task at high speed. A variable number of these units can be connected to a master program unit—and this in turn may be linked to a similar, but not necessarily identical, group. This enables a personal and integrated combination of independent units: card reader, card reader/punch, printer, electric or electronic calculator, magnetic drum, multi-selector and magnetic tapes. Any one of these may be added to an original installation *on site*.

Each of the electro-mechanical machines operates at 300 cycles per minute. It is thus possible to punch and read cards, perform calculations and print out information at this speed. This rate is in reality considerably higher, since many functions may be performed in parallel. Furthermore, much of the preparatory work necessary with conventional equipment can now be avoided by the *simultaneous* use of two or more reading units. Time-saving can thus be considerable. For example, the following operations can be carried out in a single run: matching movement cards—tabulating, punching and collating new stock balance cards—printing "new stock" positions—printing issues/receipts journals.

Among the interesting new advances incorporated in the 300 D.P. Series are the independent dual feed, by means of which the basic speed of a single printer may effectively be doubled; and the autonomous action of the multi-selector and its tape-readers, as well as simultaneous reading and writing.

Two computer applications will be demonstrated on the stand: materials scheduling and stock control, and chain store invoicing. Additional demonstrations will be given on the Posting Interpreter (the updating of visible record cards), the Tabulator (invoicing) and the I.P.C. Ledger Posting Device (the posting of customer accounts).

(*d*) The *Gamma* 60, one of the world's largest data processing systems, will be represented on the stand in the form of a scale model, together with illustrations of several installations now working in Europe. Designed for a wide variety of applications both commercial and scientific, the *Gamma* 60 is extremely flexible and fully expansible: a virtually unlimited number of input/output units may be used, capable of processing data simultaneously.

Stand 26. Creed & Company Ltd.

(*a*) Highlight of their display will be the new self-contained, *electromechanical* data processing system. Making its first public appearance, the system incorporates many elements of DORIS (direct order recording and invoicing system), developed for Shell-Mex and B.P. Ltd., which marked Creed's entry into the field of integrated data processing systems (*The Computer Journal*, Vol. 4, p. 150).

Under the control of a single operator, the system records sales orders via keyboard or pushbutton input unit, automatically retrieves stored data from a 60 m.p.h. punched tape memory, performs price calculations if required and selectively prints a variety of documents needed for manufacture, delivery and invoicing at multiple local or remote locations. In addition, it tape punches accounting and statistical details for automatic processing by punched card equipment or electronic computer.

Several hundred orders can be handled daily and a com-

plete system is priced from £6,000, cutting the cost of automatic data handling to a new low level of economy.

This outstanding speed/price ratio, coupled with tailor-made flexibility, small physical size, economy of operating staff and low maintenance makes this new system an attractive proposition for the smaller organisation (or area office of the larger concern) seeking faster and more accurate methods of handling complex clerical tasks, but whose needs do not justify the use of costly, large-scale electronic equipment. The demonstration is expected to cover a spare-parts ordering routine, where customers' orders are received by telephone in a sales office, the output units being located in different departments, one assumed to be at a remote factory.

(*b*) Also to be shown, is a wide range of computer peripheral equipment, including two high-speed output machines both of which are the fastest of their kind in the world today. One of these, the Model 3000 Tape Punch, is already in production and service (it was shown as a prototype at the first Computer Exhibition), and is designed for direct on-line recording of computer output in 5-, 6-, 7- or 8-track paper tape at a speed of 300 characters per second (3,000 words per minute)—several times that of the majority of output punches in use today.

The machine at the exhibition will feature a code "check-back" device, a new optional facility that provides for the automatic photoelectric inspection of the codes punched in the tape. It operates three characters after the punching point and can be arranged to stop the machine or signal an alarm in the event that a discrepancy is detected between the code punched and that supplied from the computer.

(*c*) The other high-speed machine is the Model 1000 Output Printer, which will also be making its first appearance as a commercially-available production model. A serial (character-by-character) printer, it is designed for use as an economical direct on-line computer output device or off-line playback unit controlled by punched paper tape or magnetic tape. Speed of operation is 100 characters per second (1,000 words per minute)—*ten times* that of the fastest teleprinters at present used for computer output printing.

Printing is by an ingenious print-head consisting of 25 hydraulically actuated styli arranged in a compact 5×5 grid, the combined operation of which, via a conventional ink ribbon, builds up each character mosiac fashion. This arrangement does away with the limitations of solid metal type and an almost infinite number of character patterns can be obtained.

Other features include high-speed "form throw" or paper feed according to adjustable settings on interchangeable metal programme discs; variable tabulation control and adjustable platen tractors to take sprocket-fed stationery of any width between $8\frac{1}{2}$ in. and 17 in.

Single or multi-copy printing is available with a printing line length ranging from 10–150 characters depending on the width of the stationery used. Signal input arrangements provide for hard valve or transistor circuits.

(*d*) Another newcomer to be seen in action will be the "Creedomat." Comprising an IBM electric typewriter with interconnected Creed tape punch and reader units, complete with metal desk accommodating transistorised circuitry and pushbutton controls, the "Creedomat" provides for the code-punching of 5-, 6- or 7-track paper tape as a by-product of typing original documents. It also automatically interprets 5-, 6-, 7- or 8-track punched paper tape and edge punched cards into typed copy at a speed of 100 words per minute.

An array of features including selective and multiple tape punching, choice of tape widths, carriage lengths, type styles, etc., combine to make the "Creedomat" a development of major significance for a variety of office automation systems based on the low-cost punched-tape technique.

(*e*) Also on show will be the latest versions of two Creed machines already well known in the data processing field—the Model 90 Tape Verifier and the Model 7P/N Keyboard Perforator.

Hitherto both limited to five-track punched paper tape, the Model 90 Verifier is now available for handling 5-, 6- or 7-track tape, while the Model 7P/N Keyboard Perforator can now be supplied for punching 5-, 6-, 7- or 8-track tape. The latter machine also features an improved, restyled cover incorporating a hinged Perspex section that encloses the punching mechanism against damage or dust, and is equipped with a larger copy-holder to provide greater convenience for operators encoding lengthy computer programs, etc.

Stand 28. James Wilkes Ltd.

(*a*) *Combiner Style Stationery*

High speed "on-line" output printers demand that continuous multi-part forms should be gummed together at one or both sides for trouble free continuous operation, and Wilkes offer their continuous COMBINER style stationery for this purpose. This stationery, whilst operating perfectly, is not easily handled after the writing stage, since without first removing the gummed edge it is not possible to decollate the sheets into separate packs, and extract the carbons, except by manual methods.

(*b*) *Automatic Trimming for Decollation*

Wilkes overcome the major problems of handling gummed edges on Continuous Stationery, by fitting trimmers on their new HIGH SPEED DECOLLATOR. Wilkes' "AUTOMATIC PAPER HANDLING" system, together with a new design in stationery, enables clean and speedy decollation to be effected, and still allows high-speed separation of the continuous decollated packs afterwards.

(*c*) *Marginal Holes—Recollation—and Wilkes FORM CUTTER*

If the marginal holes are trimmed from the continuous forms in order to decollate carbon, this would seem to remove the possibility of further "AUTOMATIC PAPER HANDLING." When designing forms for side-gummed stationery a small addition to the form width should be allowed. With this increased space a double line of marginal punching can be incorporated on one edge. Then when trimming with the new Wilkes DECOLLATOR the outside holes are trimmed off, so removing the gummed-side stub and freeing the stationery and carbon, but leaving the second or inside line of marginal holes for subsequent *recollation* by the DECOLLATOR, and for high-speed separation on Wilkes FORM CUTTER. The line of side marginal holes opposite to the stub will not be trimmed until on the FORM CUTTER.

(*d*) Wilkes FORM CUTTER separates marginal-punched stationery after initial processing on tabulators, output printers, teleprinters, etc. Operating at 6,000 forms per hour, irrespective of depth; the FORM CUTTER accurately guillotines multiple- or single-part continuous stationery.

(e) Wilkes HIGH SPEED DECOLLATOR can handle continuous multi-part sets collated together, loose, or side gummed continuous stationery. Carbon is removed at high speed into easily removable bins for disposal. A standard facility enables the user, by a simple switch, to recollate forms together after carbon has been removed. This is extremely valuable where forms must be kept together for subsequent processing.

Stand 32. Benson-Lehner (G.B.) Ltd.

This Company, located at Southampton and a subsidiary of the Benson-Lehner Corporation of Santa Monica, California, plans to exhibit:

(a) An Electroplotter Model J drawing graphs automatically from data presented on magnetic tape;
(b) An Electroplotter Model E similarly drawing graphs from data presented on punched tape; and
(c) The Oscar Model E trace assessment system—in use on strip chart records such as those emanating from flight test of aircraft or missiles.

The points of interest on the Electroplotters are:

(1) Their DIGITAL controls for origin offset and scaling;
(2) Their versatile editing facilities—selecting relevant information from a vast mass of data available on punched tape or magnetic tape; and
(3) The Electroplotter Model J's high speed of operation —up to 4,500 short lines per minute under control of magnetic tape.

The Oscar Model E is a development of a trace reading system which they have had in production in Southampton for the last four years. The particular features of the latest model are:

(i) The elimination of potentiometers for origin offset and scaling, and the use instead of a simple serial keyboard; and
(ii) The virtually unlimited number of scaling channels available—on the standard machine 10 but expandable up to 100.

As well as the three major systems, they also plan to be exhibiting a number of components, such as shaft coders with many divisions, in a case as small as $1\frac{1}{16}$ inches in diameter.

The exhibits on this stand will be of particular interest to our members working in the analogue computer field and to users of digital computers requiring to print graphs, etc.

Stand 34. Dobbie McInnes (Electronics) Ltd.

The information received from this Exhibitor indicates that he expects to demonstrate the following applications of his equipment:

(a) *Weather-Map Plotting*

The input received on teleprinter tape will be read and plotted in numerical and symbol form around the station position.

(b) *Radar Tracking Plotters*

Up to nine tracks can be shown, each as a series of symbols.

(c) Conversion of machine drawings to digital information for machine tool control.
(d) A Polar Plotter having considerable uses in the examination of aerial transmission configurations and in servo-mechanism work.
(e) Standard Trace-Analysis Units—output to an IBM typewriter.
(f) Digital input graph plotting equipment (D-MAC) responding to punched tape in *Mercury* code.
(g) A generator of a function of two variables designed by R. A. E. Farnborough.
(h) Galvanometers and other measuring and recording equipment.

Stand 38. Lamson Paragon Ltd.

Outside the scientific aspect of an electronic computer, the word "Computer" is synonymous with speed and accuracy in commercial accounting and statistical work, and it is on these factors that Lamson Paragon lay claim to the title of A.D.P. Consultants.

Economical operation of a high-speed output printer is governed, to a greater or lesser degree by the trouble-free flow of the continuous stationery on which interpreted data is printed, which in itself is governed by the method of form control used on the output printer. It is in these two spheres that the Lamson Paragon organisation provides a vital contribution to automatic data processing.

(a) *Precision Form Design*

Lamson Paragon show a full appreciation of the necessity for mathematical precision in design and layout of continuous stationery used for recording interpreted data. With 75 years' experience in business form design behind them, Lamson Paragon are experts in the preparation and printing of multi-copy forms for use in output printers.

Sustained high-speed output from an automatic data processing unit demands the highest degree of accuracy in continuous form design. Uninterrupted output is the secret behind economical operation of any electronic computer: the assistance rendered by Lamson Paragon in achieving this objective is acknowledged by O & M executives from a variety of industries. Evidence of the many types of applications in which mathematically precise form layout, coupled with elegant design play their part in maintaining fast output will be found on Stand No. 38.

(b) "*Formaliner*" *Form Feed Equipment for Perfect Form Control*

In the sphere of continuous form control the developments made by Lamson Paragon with their "Formaliner" form feed equipment require little introduction to our readers. Paragon pioneered the principle of tractor control of marginal punched stationery, whereby six pins in a flat plane, gripping the stationery at each side, provide perfect form control and multi-copy alignment.

In addition to fast form feeding, Paragon have reduced the cost of carbon paper expenditure with their "Formaliner" controlled carbon form feed equipment. Rolls of carbon paper feed at an imperceptible rate through the various parts in a set of continuous stationery, thus achieving economy of carbon paper on all types of electronic data processing machines.

(c) *After Printing, Distribution*

It is clear that the after-printing operations must be carried out at speeds commensurate with the speed of printing. To this end Lamson Paragon have developed a series of decollators and form detachers for high-speed operation.

(*d*) *New Equipment for Speedy Forms Separation*

A new high-speed decollator will be shown for the first time, which in addition to separating forms up to 300 ft. per minute, winds up the carbon paper for clean and easy disposal.

The maintenance of high speed in post-output operations is a feature which is adequately covered by the Paragon range of form detachers.

The recently introduced forms detacher (Guillotine Model) is an excellent example of precision engineering. Slim line in appearance, thus occupying a minimum amount of office space, the new Paragon guillotine will cut and stack single or multiple part forms in sizes varying from 12 in. deep to as narrow as ½ in., at speeds up to 5,000 sets an hour.

Alternatively the Paragon burster is capable of rapid separation of continuous forms at the cross perforations.

(*e*) *Paragon Form Feed Equipment Speeds Output from Creed "75" Teleprinter*

The highlight of the Lamson Paragon stand will be a demonstration of Paragon continuous stationery being processed on a Creed "75" teleprinter fitted with Lamson Paragon "Formaliner" continuous form feed, to resemble part of the system operating at the recently opened Computer Centre at Barclays Bank Ltd., London.

In this system, customers' statements are prepared from punched tape output from the computer, interpreted by the Creed teleprinter, and transmitted to branch banks, where they are printed on duplicate statements in continuous form. Added interest in this particular demonstration will lie in the first public showing of the Paragon Electric Linefinder, which is fitted to the Creed Teleprinter and represents a tremendous step forward in sustaining fast documentary output.

The Paragon electric linefinder operates in unison with the coded tape from the computer. At the completion of each set of information being printed out, a "stop" throw is brought into operation, which automatically activates the Paragon electric linefinder. A fast, positive vertical throw is then made from the last writing line of one form to the first writing line of the next.

This demonstration will vividly illustrate the manner in which Paragon form-feed equipment plays an essential part in transmission and reception of data output at speeds commensurate with that of the whole computing process.

Stand 39. Sperry Gyroscope Company Ltd.

Three new Magnetic Storage Drums—designated Types C, D and E—will be on show. In company with the Type A and B now serving in G.P.O. telephone exchanges, they offer practical evidence of the Company's intention to increase its range until it fulfils every major need. Common features claimed are high capacity in relation to cost, hence an unusually low cost per bit, and long-term reliability associated with the Company's name. The availability of pick-up heads and associated circuitry means that Sperry can offer complete drum units.

A special feature of the Type C and the Type E (a low-speed drum, 16-inch diameter) is the ease with which slave units can be added, to multiply the original capacity, up to four times if need be. With a drum diameter of only 3 inches, the Type D forms a contrast. This high-speed small capacity unit has wide application to transport, in the air, on or under the sea, or in land vehicles.

Stand 41. Ampex Great Britain Ltd.

Ampex will be exhibiting their range of advanced design magnetic-tape handlers for computer applications. These machines are used in many British-made computers.

Of major interest in this field will be the TM-2, a new high performance machine developed from the successful FR 300 series, which found wide acceptance in the United Kingdom. The TM-2 is capable of consistently meeting a start/stop time of less than 2 milliseconds, and has at present a packing density of 300 bits per inch. A new development, the DE-1 electronics, will further improve this figure to almost 600 bits. Both these equipments will be on display for the first time in the United Kingdom at this exhibition.

The Ampex FR 400 is a lower speed digital tape handler, for on or off line applications. This machine has recently undergone some redesign, and this further developed version will be on show for the first time. The modified transport design has, amongst other features, devices to improve the tape packing.

New to most British users will be the range of ferrite-core memory systems, now manufactured and marketed by Ampex. This addition to the range of computer equipment has been brought about by the acquisition of Telemeter Magnetics Inc., of Culver City, California, by Ampex Corporation. This range of general purpose core memories has a high speed of operation, and can be used in a wide variety of applications.

Also available are a selection of computer memories having cycle time of 1·5 μseconds to 20 μseconds.

By the use of Ampex core-storage buffers, synchronisation of data systems of differing speeds may be achieved.

Also on show will be a complete range of precision tapes for computer applications, in a variety of configurations, including IBM compatible types.

Stand 42. Fanfold Ltd.

Fanfold Ltd. will show for the first time in any exhibition:

(*a*) FAN-FLEX Continuous Stationery—Continuous forms with a fully flexible stub in which carbon and paper are free to move in relation to each other, thus ensuring trouble-free feeding on high-speed computer output printers.

(*b*) FANFOLD TAB-CARD SETS which combine one-time carbon sets and cards for punched card machines enabling all data to be recorded at the point of entry and eliminating transcription errors.

(*c*) FANFOLD DE-COLLATOR which removes one-time carbon paper from continuous one-time carbon sets and separates the forms into individual parts.

(*d*) FANFOLD CARBALINE FEED FOR CREED MODEL 75 TELEPRINTER. This redesigned feed incorporates certain revolutionary principles which produce a compact and highly efficient feed mechanism, which eliminates the need for one-time carbon.

(*e*) FANFOLD FORM JOINER. The Form Joiner enables continuous sprocket-punched forms to be joined together by means of special perforated strips thus reducing the time spent loading forms on to computer output printers also reducing form wastage by enabling uneconomic short runs of forms to be joined.

Also on show for the first time in the Computer Exhibition will be the *Weber Marking System*, which enables a stencil to be produced as a by-product of the operation of producing documents. The stencil is used in a hand printer to print addresses, etc., direct to cartons, thus eliminating labels. Other items on display which have been shown previously

will include Continuous Wage Envelopes, Fanfold Fimafold Continuous Form Guillotine, Fanfold Carbaline Creep Feeds and Fanfold Continuous Forms for use with Computer Outputs.

Stand 43. Leo Computers Ltd.

On this stand, located in the gallery, visitors may expect to see parts of a Leo III installation. A magnetic-tape deck and an Analex printer will be connected to their control and assembler cabinets, and a paper-tape reader will be operating at 1,000 characters per second, under control of an input assembler. A control desk and an engineer's control cubicle will also be exhibited. A specimen core-store matrix will be on show.

Specimen packages and certain other details of the computer will be available for closer inspection, and staff will be available for preliminary consultation on various applications, or to answer questions on the exhibits.

Stand 45. Jenkins Fidgeon Ltd.

This Company will be exhibiting a full range of Ancillary Equipment specially designed for Computer and Punched Card users, and will include the following:

A new range of steel desks for programmers, supervisors, machine operators. Storage cabinets and cases for magnetic-tape reels. Storage cabinets for spare packages and printed circuits. Filing cabinets and cases for paper tapes, including bobbins and spoolers.

A new method of storing paper tapes, either in short lengths or reels up to 6-inch diameter in the same unit.

A range of 80 column and 40 column punched-card ancillary equipment, including some new open-access filing desks, with roller shutter.

Some items for the new IBM 3000 80 column punched-card system.

Stand 46. The General Post Office: Inland Telecommunications Department (Sales Division)

Electronic computers of the new generation are faster and more efficient than their predecessors, and this trend is now towards centralised installations. This development creates a need for line transmission of data, in a form suitable for processing, and the Post Office, aware of the value of increased industrial and commercial efficiency, is developing facilities to meet the demand for data transmission.

The G.P.O. will be exhibiting communication services suitable for data transmission, and are ready to explain how they may best be used.

(*a*) *Low Speed Transmission* (*up to* 50 *bits per second*)
Telegraph Circuits

Private circuits and equipment for preparing, transmitting and receiving punched paper tape using the standard international 5-unit code, may be rented. Alternatively, if Post Office approved, privately owned terminal equipment may be used.

TELEX

Data can also be transmitted over the public telex network. The standard equipment uses the standard code, but installations can be modified to enable data in other 5-unit codes to be sent and received on punched paper tape. Privately owned equipment—which may use other than 5-unit—can be connected to line by a special switching device during a telex call.

A method of detecting transmission errors is demonstrated on the stand.

(*b*) *High-Speed Transmission* (500 *or more bits per second*)
Speech Type Circuits

Private circuits are generally available, having speeds up to 2,000 bits per second. Higher transmission speeds require better quality circuits, and special provisioning arrangements may be necessary, adding to the cost and the provision time. Using approved terminal equipment, it is possible to transmit data on the public telephone network by ordinary telephone calls. Speeds of 600 bits per second are obtainable. Information about a new Post Office modulator-demodulator will also be available.

Stand 49. Punched Card Accessories Ltd.

This Company will be showing a fully comprehensive range of PCA data processing auxiliary equipment for every kind of computing and tabulating machine installation.

Among new items "pioneered by PCA" are important additions to the ExtensiPull Desk File range; the remarkably flexible "StorMost" Magnetic Tape Storage System, as supplied to the Royal Army Pay Corps Electronic Accounting Development Unit at Worthy Down, and other interesting computer installations; and everything that may be called for by way of ancillary equipment for the new IBM 3000 Accounting System.

PCA believe that they are still the only Company in this country concentrating and specialising *solely* in the production of original, efficient, and inexpensive data processing auxiliary equipment, and all visitors to the stands will receive a warm welcome and any advice, information or assistance that they can give them, quite without obligation.

Stand 50. The British Computer Society

We shall exhibit specimens of our publications and those of certain overseas Computer and data processing societies which may be purchased through the Society's Office.

New members will be recruited and orders taken for publications. An interpreter will be in attendance to assist overseas visitors.

We hope that members and subscribers will visit this stand and introduce their colleagues. It is hoped that at least one member of Council or the Editorial Board will be available, together with a member of the office staff, to meet visitors throughout the duration of the Exhibition.

* * *

Other Exhibitors, from whom notices were not received in time, are expected to include AEI (Stand 15); Short Brothers and Harland (16); I.C.T. (21); MSS Recording (33); Plessey (44); and Mullard (47). Several publishers will have stands and there will be banking facilities, restaurant, etc.

Speeds, model numbers, capacities, costs and notes on availability, etc., have been quoted from notices received from intending Exhibitors. No Editorial undertaking can be given for accuracy; such details frequently change and interested readers should check them carefully with the Exhibitors concerned, before attempting to rely upon them. We have aimed only at providing a Preview, *which would stimulate interest and business at the Exhibition.*

NEWS FROM MANUFACTURERS

Owing to pressure on space, several items have been held over

Midland Bank

The Midland Bank has placed an order with *The English Electric Company* for a KDP 10 electronic computer system, which will service all the current accounts—amounting to well over 100,000—of 60 branches in the London area. The English Electric computer, which will cost about £250,000, was chosen after an intensive study and assessment of many types of data processing system available and will be operational during the autumn of next year.

The basic principle of the system is the maintenance of all the branch current accounts records centrally on magnetic tape, and ledger posting from the tape files according to the information fed in daily from the branches.

The intention is to set up a computer centre in the West End of London, and to equip each of the 60 Midland branches with accounting machines fitted with special attachments to produce punched paper tape. The paper tapes carry all branch data for feeding into the central computer and this is done at the rate of some 1,000 characters a second—equivalent to about 40 cheques or credit vouchers every second. Coupled to high-speed printers producing print at 600/900 lines a minute, the computer will sort and "post" in only 4½ hours the information fed in from the sixty branches. Customers' statements and copies for the Bank's records will be produced in one operation. The bank estimates that a staff of from 10–12 will be required at the computer centre to control the work of the system.

Planning and programming of the system is being undertaken by the Research section of the Midland Bank's Machines department, working with staff from English Electric, who will be attached to the Bank for several months.

The KDP 10 system is being built at English Electric's Data Processing and Control Systems Division at Kidsgrove, Stoke-on-Trent, where similar systems recently ordered by the *Commercial Union Group* and the *Yorkshire Electricity Board* are currently in production.

Computer to Aid GCE Procedure

London University has ordered a Type 1301 Electronic Computer from *International Computers and Tabulators Ltd.* for use in the pre and post examination processes associated with the GCE at both "O" and "A" levels.

For the past three years the University has been using ICT standard punched-card equipment for this work, during which time the number of candidates sitting the examination has been steadily increasing. The number is expected to rise to some 170,000 in the summer of 1962, involving the marking and evaluation of some 800,000 papers.

To meet this increasingly large commitment, the University examination authorities have decided to introduce the faster and more progressive methods of data processing available through the use of a modern high-speed electronic computer. By these means, the vast administrative load associated with preparing for the examinations will be eased, and the processing of candidates' marks will be speeded up to provide early publication of results and issue of certificates to successful candidates.

There is much preparatory work to be done between the receipt of entries for the examinations and the examinations themselves. Entries have to be checked for validity and to ensure that there are no clashes in any candidate's examination timetable. The number of papers required for each subject at each examination centre has to be established, and packing lists prepared for each centre. Attendance registers and mark sheets have to be prepared and the number of required examiners calculated. All this work will be undertaken by the computer which also will produce the required documentation.

A very special problem of London University is the allocation of some 12,000 private candidates, who sit the examination in the London area, to suitable examination halls which are taken over for the occasion. Allocation has to be such that there are no location or timetable clashes in the arrangements made for any one candidate and that candidates are not required to travel unduly from one examination centre to another. The computer will deal with this otherwise complex and time-consuming problem automatically and at high speed.

There is, not surprisingly, great pressure on the University to complete the marking of candidates' papers, publish results, and distribute certificates to successful candidates as soon as possible after the examinations are concluded.

The marking process is complicated by the large number of examiners—some 2,000 are involved—the wide variety of subjects covered by the GCE examinations, and by the problem of converting examiners' marks as quickly as possible into computer language. In this connection, the University makes use of the ICT card mark-sensing technique whereby examiners record the individual candidate's mark in pencil on standard punched cards. On receipt of these cards at the University, they are mechanically processed to convert the pencil marks into punched holes in the cards, which can then be read at high speed by the computer.

Special problems arise in connection with certain subjects, such as English and Mathematics, where, because of the number of candidate's papers involved, many examiners are engaged in marking the same subject. Making full use of the power of the 1301 Computer, comprehensive mark distribution tables will speedily be made available to the Board of Examiners, who will thus be presented with a ready facility for achieving standardisation of marking for the subject as a whole.

The calculation of pass grades, in accordance with the standards set by the Board of Examiners and on the basis of the marks awarded by the examiners, is performed by the computer. In the same computer process the final results tables are produced and printed. Details of the examination results will thus be available for distribution to schools at an early date after the completion of the examination. The high speed printer of the computer will also be used to produce pass certificates for issue to successful candidates.

London University's use of the ICT 1301 Computer System

will, it is hoped, greatly reduce the time involved in completing the mammoth and painstaking task of assessing marks, calculating pass grades and publishing results and certificates. Moreover, the computer will provide the University with the facility for a much more detailed analysis of examination performances and results than has hitherto been possible.

Bristol College of Science and Technology

The Bristol College of Science and Technology is to equip its Department of Mathematics with a National-Elliott 803 Electronic Digital Computer. It will be the first educational establishment in the South-West of England to acquire a computer, and the first in the country to have a machine which offers such a wide range of facilities.

The 803, which will be installed in October 1961, has provision for both punched-tape and punched-card input. It includes magnetic-film file storage and an automatic floating-point arithmetic unit. The installation will enable students to acquire skill in all aspects of computing work and will provide members of the staff with a system fully capable of handling the wide range of computational tasks which they are likely to encounter in the course of their work.

The computer will be in demand both by the staff and by post-graduate students for research work. In addition, Diploma students at the College will be taught to use the computer as part of their mathematical training and will then use it in the course of their project work.

European Computer Manufacturers' Association

An announcement was made in July of the establishment of the European Computer Manufacturers' Association (ECMA) with headquarters and secretariat in Geneva.

Members of the Association are companies in Europe which develop, manufacture and market data processing machines designed to process digital data for business, engineering, scientific and other similar purposes.

The object of the Association is to further the adoption of data processing standards for the benefit of users, the public and the industry itself. Its primary purpose, in co-operation with national and international standards organisations, is to secure inter-company co-operation throughout the industry which will enable European manufacturers to offer better products and services at less cost. This is to be accomplished through the establishment of systems and equipment compatibility, the development of common systems languages and in other appropriate fields of activity. Standardisation in these areas will furnish a basis for passing information from one data processing system to another, for performing similar processes on differing machines and for reducing the effort needed to prepare programs for the operation of data processing equipment manufactured by members Companies.

Already three technical working committees are in being. These are concerned with: (*a*) Codes representing characters for use in computer "input" and "output," (*b*) Common programming languages, (*c*) Diagrammatic and symbolic representation of processes. A fourth committee, now in formation, will deal with character recognition.

The first President of ECMA is Mr. C. G. Holland-Martin, Research Director of *International Computers and Tabulators Ltd.* Monsieur P. Dreyfus, *Compagnie des Machines Bull*, is Vice-President, and the Association's Treasurer is Signor M. R. Pedretti, *IBM World Trade Corporation*, France. Other Manufacturer-members are:—

Aktiebolaget Addo, Sweden.
Associated Electrical Industries Ltd., England.
Electrical and Musical Industries Ltd., London.
N.V. Electrologica, Netherlands.
Elliott Brothers (London) Ltd.
English Electric Company Ltd., England.
Facit Electronics AB, Sweden.
Ferranti Ltd., England.
ITT Europe, Inc., Belgium (represented in Great Britain by *Standard Telephones and Cables Ltd.*).
Leo Computers Ltd., England.
Olivetti S.p.a., Italy.
S.E.A. (Societe d'Electronique et d'Automatisme), France.
Siemens and Halske AC, Germany.
Telefunken C.m.b.H., Germany.
Zuse KC, Germany.

Prudential Assurance

The IBM 650 Computer ordered by the *Prudential Assurance Company Limited* in December 1960 is now installed in the Company's offices in Holborn. The computer is being used to prepare the weekly payroll for 3,000 employees and the ultimate intention is to take over the payroll for the entire staff.

Barclays Bank Limited

On Tuesday, 4 July, The Postmaster General, The Right Honourable Reginald Bevins, M.P., formally opened Barclays Bank No. 1 Computer Centre at 154 Drummond Street, London, N.W.1.

The opening of this Centre marked a stage in the development of automation in banking. It is believed that its combination of transistorised computer and telecommunications constitutes the most advanced bank book-keeping system in the world.

When the first computer, an EMIDEC 1100, is fully operative it will handle the book-keeping of 40,000 accounts at twelve of the Bank's West End branches. In view of the existing pressure on the Bank's staff, no problems of redundancy will arise, either now or as further computers are brought into use; economies of staff and of premises are of course the Bank's main objectives in introducing this form of centralised book-keeping.

All branches served are connected to the Centre by teleprinter lines, over which information regarding customers' entries is passed. By these means it is possible to avoid the movement of vouchers away from the branch. At each branch one or more accounting machines with paper-tape punching attachments are installed. On these machines a journal is prepared analysing and proving all entries passing through the branch. As entries on customers' accounts are entered in this journal details are punched into the paper-tape as a by-product of this audit operation. Accounts are identified by account numbers, these numbers being printed on cheques and paying-in books as issued to customers.

At intervals the punched paper-tape is transmitted over the teleprinter lines to the Centre, where a duplicate tape is automatically produced. Before these tapes are passed to the computer they are checked electronically to detect very occasional punching or transmission errors. The computer

would in fact find these errors itself, but by disposing of these errors in advance the introduction of this input checking equipment (ICE) allows the computer to operate at its greatest efficiency. ICE was designed by a member of the Bank's staff, as there was no equipment on the market, or under development, which would perform this checking function, and considerable interest has been aroused in the data processing field by this machine (*see p. xxi*).

After checking, tapes are fed into the computer through a high-speed photoelectric tape reader. Magnetic tapes bearing a complete record of all customers' accounts to date are mounted on the magnetic tape read/write machines, and this information is also fed into the computer. The main computer operation is then to combine these two sets of information—the old record and the day's entries—and to record on a second magnetic tape an up-to-date account history. During this operation new balances are obtained which are compared with limits, and interest, turnover, and other statistical calculations are made. While this operation is being carried out a punched paper-tape containing the details required by the branch manager for the day-to-day control of his accounts is prepared. This tape is transmitted back to the branch over the same teleprinter lines as were used for bringing the original information from the branch to the computer, and a record is printed out in the branch.

Customers' statements are prepared on a diary or cycle basis, with a copy for retention by the Bank as a ledger. Calls for statements are fed into the computer together with the up-to-date account records. Once more, paper-tape serves as the output; once more, the teleprinter network is brought into use, and the statements are printed out in the branches, ready for dispatch to customers, on Creed teleprinters equipped with Lamson Paragon FORMALINER continuous form-feeding equipment, using roll carbon paper, and the electric line-finder device.

Remington Rand Ltd.

Late in 1960, a UNIVAC SOLID STATE 80 Computer was installed at Remington House, London. As the first commercial UNIVAC installation in the United Kingdom, this computer has been extremely hard worked on handling internal Remington Rand accounting and statistical work. It is also used for program research and testing, for training, for demonstrations and for development of commercial programs.

A number of very effective commercial computer programs have been produced and are available to be demonstrated. These show the UNIVAC as a practical business machine doing large volumes of day-to-day work accurately, reliably and speedily. When the USS-80 was installed a decision was taken not to publicise the new installation widely, but rather to get on with the job of showing what UNIVAC could do in a practical manner. Remington Rand Ltd. are now issuing an open invitation to see UNIVAC in operation; and for the purpose of keeping customers up to date with UNIVAC activities, the *UNIVAC News* has now come into being.

The first regular issue of *UNIVAC News* was a general announcement to persons who have indicated their interest in the past. *UNIVAC News* will appear monthly. It will describe new developments in both the hardware and software areas. Applications and new installations will be included, as well as news items of general computer interest. It will not attempt to be too technical, but will rather serve as a bulletin for UNIVAC activity in this country. Further information can be obtained from *Remington Rand Ltd.*, 65 Holborn Viaduct, London, E.C.1, mentioning *The Computer Bulletin.*

"Leo to the Rescue" after Pay Robbery

When car-using bandits struck at the *Ford Motor Company's* Dagenham works on 22 June, pay packets for 700 night shift foundry employees were stolen. But all the men received their wages only a few hours after the normal paying-out time—thanks to the newly installed LEO electronic computer.

As soon as news of the raid came through, Mr. E. Knight, manager of the computer operating department, realised that a new payroll would have to be prepared. He had all the data re-fed into LEO and a duplicate payroll for 2,100 day and night shift foundry workers was produced within the hour. The day shift men, who had been paid before the robbery, were separated out, and 700 new wage packets made up for the night shift.

"We didn't anticipate LEO would ever have to cope with the consequences of a wage robbery, when we installed it at the beginning of the year," said Mr. Knight, "but we would have been in more serious trouble without it. Making up a new payroll by conventional means would have been a very much longer operation than it was with LEO."

(The *Ford Motor Company* has two LEO computers—one at the spare parts depot at Aveley, and the other at Dagenham.)

R.A.F. Computer

The Royal Air Force Station at Hendon is to house a computer which will be the focal point in the RAF world-wide supply network.

A contract has been placed for an AEI 1010 electronic computer which will be delivered to Hendon in May 1962.

Work has already begun on the site for the building which will house the computer centre. It will be alongside the original control tower set up by the pioneer aviator Mr. Claude Grahame-White in 1910.

The supply of spares for modern aircraft and guided weapons is complicated and costly; to buy, store, issue and account for some 700,000 different items presents a problem which can be handled efficiently only with the help of modern data processing equipment. As well as the computer, the Hendon centre will house much ancillary equipment. There will be communication links with every RAF station and depot at home and overseas, and 200 staff will be employed there.

The computer will deal with 4,000 messages an hour, which will flow into the centre daily, reporting the requirements from units, the stock and issues. These will be processed overnight for action next morning. Concurrently, urgent demands will be received day and night to keep aircraft flying and will be acted upon within an hour of reaching the centre.

Honeywell 800

This medium-to-large system is the only computer yet developed that will perform up to eight independent computing operations concurrently. For example, it will answer a random enquiry, bring an inventory up to date, process a payroll, perform a complex engineering calculation, make a special analysis, and handle *three* other jobs—*at the same time.* Other unique features are orthotronic control (the

ability to detect and correct errors without human intervention) and Honeywell's extensive library of automatic programs. The computer is of a modular design that will allow virtually unlimited expansion. Average speed is 40,000 three-address operations per second. The Honeywell 800 has been designed to suit both scientist and businessman. It has been chosen by Massachusetts Institute of Technology as a scientific computer, by *Metropolitan Life* as a business computer, and by several organisations for both scientific and commercial use.

Cash price for the average system: £395,000. Monthly rental: £8,500.

Honeywell 400

The Honeywell 400 is the junior version of the Honeywell 800. It is a full-scale magnetic tape data processing system for small organisations. It will be attractive to the large number of companies which could derive great benefit from a magnetic tape system, but which have so far been unable to consider buying one because of their cost. Invariably such companies now use a sophisticated punch-card system, the cost of which is comparable to that of the "400." It is claimed that the H400 gives magnetic tape *and* card processing, at card system cost.

The "400" and "800" use the same tape units and other auxiliary equipment. Any program prepared for the "400" can be run on the "800." This "compatibility" of the two computers means that it is easy for a growing company to change from "400" to "800" as soon as its processing needs warrant the larger system. Also the compatibility is useful for decentralised companies: programs run on local "400's" can be easily integrated with programs run on the head office "800."

The "400" can handle an average of 10,000 three-address operations per second. Monthly rental: £3,090. Cash price: £139,000. This includes the central processor, an independent console, four high-speed magnetic tape units (96,000 dd/sec.), a 900 lpm printer and a 650 cpm card reader.

New Creed Equipment

The expanding use of 6- and 7-track punched paper tape in the computing and data-processing field has created a need for a Tape Verifier capable of handling these expanded codes. A new version of the Creed Model 90 Tape Verifier meets this need and is now available for 5-, 6- or 7-track tape verification.

Designed specifically for data processing applications, the Model 90 provides means for automatically detecting and eliminating operator errors in the punching of 5-, 6- or 7-track tapes at speeds up to 15 characters per second. The Verifier consists of four separate inter-connected units of Creed punched-tape equipment: a Model S 4136 Multi-wire Keyboard, a Model 92 Tape Reader, a Model 25 Tape Punch and a Power Pack.

Operation of the Verifier is based on the automatic comparison of two separate transcriptions of the same source data. The unverified tape is fed into the tape reader and the data typed out a second time from the source document. The units are electrically interconnected in such a way that when the code produced by the second typing agrees with that already punched in the original tape, the same character is punched into a second tape.

When the two codes do not agree, the keyboard locks and nothing is punched on the second tape. After determining whether the error was in the first or second typing the operator takes appropriate action so that the correct character is punched in the second or verified tape.

Another new version of the Model 90 the Verifier-Reproducer Set which incorporates a Creed Model Seventy-five Teleprinter with tape punch attachment in place of the Model 25 Tape Punch. This further extends the versatility of the equipment by adding page printing, tape editing and tape interpreting facilities to its existing capabilities.

The keyboard unit of the Verifier-Reproducer is of a new design and incorporates a number of new features. One of these is a special high speed "skip" facility which enables the operator to make the tape reader pass over any redundant data and stop at the first character after the unwanted characters. Another feature is the inclusion of warning lamps which give the operator a constant indication of the parity or disparity of the character being verified.

Now in full production, the new Creed Model 90 Verifier is priced between £513 and £663 (according to tape codes required) while the new Verifier-Reproducer Set sells at £1,200.

A New IBM Disc Storage Unit

An entirely new random access disc storage unit to be used in conjunction with a range of computers has been announced by *IBM*. This unit is large enough to store the complete records of most businesses, yet allows access to any of these records in thousandths of a second.

Known as the IBM 1301, the new unit holds up to 56 million characters of information and five of these units can be used with the IBM 1401 and 7000 series data processing systems giving a total storage of up to 280 million characters.

The IBM 1301 makes use of comb-like access arms, flying on layers of air. Data, recorded in a pattern of 250 concentric tracks on magnetic discs, is read and written by these arms. This data can be transferred between the storage unit and the computer of a speed of up to 75,000 characters per second with the 1401 computer, or 90,000 characters per second with the 7000 series—speeds considerably in excess of magnetic tape units.

Previous random access storage units had from one to three access arms which serviced the whole file of magnetic discs by moving up and down from disc to disc as well as in and out from track to track.

The IBM 1301 has an access arm for each disc surface, and the entire "comb" of 40 arms moves in unison. There are 250 tracks on each surface and the discs of the IBM 1301 can therefore be thought of as a nest of 250 cylinders, each one holding up to 112,000 characters.

The cylinder concept means that data stored on discs will be arranged differently. Instead of storing it on adjacent discs to minimise vertical movement of the access arms, on the IBM 1301 data will be stored on the same or adjacent cylinders.

Access time within one cylinder is between 0 and 34 milliseconds and access time from one cylinder to another is between 50 and 180 milliseconds. Therefore the longest time that it can take to obtain any record in the whole storage of up to 280 million characters is only 214 milliseconds.

[*continued on page xxi*

DISCUSSION GROUP NEWS

Group No. 5 Advanced Programming

During the 1960–61 season the group has had nine meetings. These were: A description of a simple experimental commercial autocode for the Ferranti PEGASUS computer, including a practical demonstration of its application to a life assurance surrender value calculation (C. M. Berners-Lee, S. Benjamin); The Manchester University Autocode System (D. Morris); The report of the discussion group's working party on COBOL: The approach to SEAL (the Standard Electronic Accounting Language) (A. d'Agapeyeff); ICT's implementation of COBOL (P. V. Ellis, E. Humby); A simple clerical procedures language developed as a research project by NCR (J. C. Harwell); The operating facilities desirable in respect of an autocode (A. E. Hodgson); IBM programming systems with particular reference to the Share Operating System (H. J. Richards); The use of list process techniques in commercial work (Miss M. E. Tribe, P. Shackleton, A. d'Agapeyeff).

The report on COBOL referred to above, and published in a previous issue of the *Bulletin*, was the result of a working party of members which met weekly over a period of several months. The discussions of the working party were not restricted to COBOL and were found to provide a valuable meeting ground for a number of members engaged in writing commercial autocodes and potential users of autocodes.

When the COBOL working party completed its report, two further sub-groups were formed. Their subjects were: Users requirements as regards commercial autocodes: The theory of compilers.

The chairman of the first group is J. Goddard, and the chairman of the second group is S. Gill. The intention is that the work of these two groups should be complementary.

In addition to the activities already mentioned, in February the group held its second dinner which was attended by over thirty members and their guests.

The group has been fortunate in having an active membership; discussion is invariably heated, and without exception meetings have had to be forcibly closed by the chairman at the appointed time.

The group aims to resume its activities in the Autumn.

Group No. 6 Production Control, Scheduling, and Stores Control

A successful series of eight meetings was held on alternate Thursday afternoons during the first part of 1961, culminating in a Group lunch at the Tavistock Hotel on 11 May. All those attending were currently engaged in, or planning the use of a computer for production or stock control, and an average attendance of 8 members was maintained.

Each discussion was made specific to one aspect of the subject, and a member with considerable experience in the particular field gave a lecturette.

The subjects covered were: Information required from Forecasting Department to feed into Production Plan: Methods of forecasting demand and protection required to avoid stock shortages: Information required on basic data files, methods of up-dating and amending: Transaction codes required: Ordering policies and control of deliveries: Analysis of orders to determine requirements of individual components and starting dates: Machine loading: Progress Control.

A meeting will be called in October to discuss the meeting programme for next year and it is hoped that a similar series of discussions will start in January 1962.

Group No. 15 Statistics

The group has not met during this year, but a meeting has been arranged for 18 September with a view to planning the new winter session activities. Under discussion also will be the possibility of extending the title to "Statistical Applications including Survey Analysis."

Group No. 17 Numerical Analysis

Stimulating discussions took place after each of the papers presented. These were: A Survey on Error Analysis for Eigen values and Eigen functions (J. H. Wilkinson); Some Applications of Chebyshev Polynomial Approximation (C. W. Clenshaw); The Numerical Solution of Parabolic Differential Equations (J. Crank).

The next meeting of the group will be on 5 October 1961 at which arrangements will be made for the whole of the year.

Group No. 18 List Processing

A new group to commence activity in October 1961.

Group No. 19 Information Retrieval

Suggested as a subject for a new group.

Members interested in joining any of the discussion groups should write now to Mr. P. V. Ellis, Putney Bridge House, London, S.W.6.

The working groups are as follows: Input and Output; General Accounting; Feasibility Studies; Operational Experience; Advanced Programming; Production Control, Scheduling and Stores Control; Statistics; Numerical Analysis.

Magnetic Tape Testing Service

Decca Radar Limited have recently established a computer tape service at their Hersham laboratories where tapes undergo a series of rigorous tests prior to being graded and supplied to computer users.

All tapes subject to these tests must comply with strict mechanical and electrical acceptance specifications; they are then graded according to their rejected regions, that is, areas of confirmed drop-out or drop-in which are shown to occur at the same positions on the tape during repeated play-back. Tapes which are completely free of rejected regions are classified as Grade 1; Grade 2 tapes may contain limited rejected regions.

The surface finish of magnetic tapes is dependent upon the base smoothness and oxide bonding agent; loose oxide particles on the tape surface, and irregularities such as pin holes, lumps of oxide and impurities are detected by the tape testing service in the early stages.

After completion of the tests each tape is coded according to its magnetic and mechanical specification and identified by a serial number printed on the backing side of the tape leader. It is then wound on a spool and packed in a dust proof polythene bag, finally being stored in either a metal or cardboard container ready for shipment.

COMPUTER CENTRES

Portfolio Valuations and Dividend Warrant Preparation

An opportunity for stockbrokers to have clients' portfolio valuations prepared on a data processing service basis by electronic machines was announced on 18 July by Mr. F. J. Nash, Assistant Managing Director (Sales), of *International Computers and Tabulators Ltd.*, at a reception for City Editors at City Gate House, E.C.2, the new home of ICT's City Service Bureau and its Dividend Service Bureau.

The portfolio valuation service, said Mr. Nash, would enable even the smallest stockbroking firm to provide its clients with accurate, up-to-date and frequent appraisals of the state of their investments. Only a minimum of elementary punched-card equipment would need to be installed on the broker's own premises; the detailed calculations would be done on electronic machines in the ICT City Service Bureau, thus saving brokers much onerous and costly manual work.

Mr. Nash also drew attention to the facilities offered to company registrars by the ICT Dividend Service Bureau, which undertakes the calculation of gross dividends, income tax and net dividends and the printing of this information on dividend warrant forms. The Dividend Bureau was first established in 1935 and remains the only one of its kind in the country. Its annual output of dividend warrants for the various public companies who are its customers exceeds one million.

London C-E-I-R Centre Opens

On 20 June 1961, in London, there opened Britain's first C-E-I-R Centre. Except to an initiated few, the designation "C-E-I-R Centre" is as unfamiliar in this country as it is familiar to big business in the United States—where, over the past few years, a nationwide network of such centres has been established by the Corporation for Economic and Industry Research.

The computer facilities offered by C-E-I-R will be provided on the IBM 7090 and 1401 data processing systems at the IBM Data Centre in Newman Street, where the London Centre also has its offices. Special offices are also provided for clients using the computer facilities on a by-the-hour hire basis, or working with programmers and statisticians on joint projects.

The *CEIR-UK-Ltd.* Company's office at 84 Kingsway will still be the administrative headquarters of the organization in the UK.

Professor Maurice G. Kendall is to join the Board. Announcing that his election will take effect from 1 October 1961, Dr. C. O. George, Vice-Chairman of the Company, said that Dr. Kendall will be responsible for the Departments of Mathematics, of Statistics and of Operational Research and their activities. He will work closely with Dr. Alexander S. Douglas, the Director of Technical Services, whose divisional responsibilities include Departments of Computer Services, of Computer Technology and of Programming.

City Computer Centre

Stockbrokers and other businesses in the City of London will now be able to use a computer service bureau which deals exclusively in their kind of work. The new bureau was opened in September by *NCR Electronics*, in addition to their commercial data processing centres at Marylebone and Neasden. A NATIONAL-ELLIOTT 803 with magnetic film file will be used initially. But before long this will be augmented by the new NCR 315 system, which has a random-access memory of unlimited capacity and is thus particularly suited to this sort of service work.

Among the jobs which the bureau will perform for clients are the evaluation and analysis of portfolios and the calculation of stock price statistics for investment analysts. Working to very tight schedules, the computer will provide statistical information which, with conventional methods, could not be produced economically or in time for it to be of any use. Strict security arrangements are being made to preserve the highly confidential nature of the information passing through the bureau.

The established NCR electronic data processing centres have already handled some work of this kind. Typical jobs include the calculation of insurance risks and premium rates, the calculation of share price indices and the processing of unit trust records.

Three-in-One Computer

EMIDEC 1100 computer installed by *EMI Electronics Ltd.* at the new showroom in EMI House, Manchester Square, London, W.1, will have three purposes.

Its main task will be the operation of a fully integrated data processing system for *EMI Records Ltd.*, including sales invoicing and monthly statements, sales statistics, stock control, production control, copyright and artistes' royalties.

Nearly 3000 sales invoices are prepared daily for any of 24,000 different titles. The public demand for popular records fluctuates so much that stocks must be kept to a minimum. The daily figures for sales and stock levels which EMIDEC gives are, therefore, invaluable. A further complication is that royalty rates vary in different countries.

EMI Group's payroll for 14,000 employees will also be prepared by the computer, which will print out the payroll slips or envelopes and produce a labour cost analysis.

Secondly the EMIDEC will test programs which have been prepared for eventual use on computers to be installed in other organisations' premises and those customers' computing staff will be trained in the operation of the machine, gaining the benefit of the experience of EMI'S own staff in operating the EMIDEC on a working basis.

Thirdly, computing time will be sold to other companies which can occasionally use the facilities of electronic data processing, but do not have a sufficient volume of work to justify outright purchase of a computer.

Editorial

ARE WE LAGGING?

Mr. A. B. Frielink's table on page 116 of this issue will no doubt receive the attention of all our readers. We seem to be falling rapidly behind the rest of Europe. Is it a pause (a current word) due to customers waiting for second generation machines? Is it due to some measure of disillusion in clerical data processing and realignment of endeavour?

To examine the position in detail one must be able to compare installations intra-nationally, sector by sector. For example, how do we rate in Government installations?

One rapidly developing sector in this country deserves special attention. Week by week we hear of the establishment of new computer bureaux. The *Bulletin* aims to present its readers with details of such services and invites the co-operation of the managers of these bureaux. The intention is to publish a list of such service centres with details of the specialised services offered.

The contents of this *Bulletin* reflect considerable interest in service bureaux. Mr. P. G. Barnes has something to say on the matter on page 119. Data transmission must also play its part and accounts of experiences in this field of work are sought by our Data Transmission Committee (page 116).

Finally we call attention to the intriguing possibility of 'take-over bids' for priority time on the larger computer installations as suggested in Mr. Peter Wegner's letter on page 129. Let us hope that the New Year brings some of the answers to the many queries raised!

SOCIETY AND COUNCIL NOTES

Third National Conference

The Society's Third National Conference will be held in Cardiff next autumn; it will run from the evening of Tuesday, 4 September, to the afternoon of Friday, 7 September 1962, immediately after the IFIP Congress in Munich.

A full programme of technical sessions is being planned covering most aspects of data processing; particular attention is being given to practical experience in commercial data-processing. There will be one or two Conference social functions, and if there is sufficient demand a programme of visits will be arranged to local places of interest.

D. W. Hooper, M.A., F.C.A., President 1961–62

A great-grandson of the William Hooper who, just over a century ago, first patented the chemical processing of rubber into a pure, malleable, "insulation for telegraphic conductors," the new President of The British Computer Society broke away at first from the family succession of electrical engineers and manufacturers of submarine telegraph cables.

Educated at Charterhouse and Clare College, Cambridge, where he read Natural Science with a view to a scientific career, he became instead a Chartered Accountant, but did not go into practice, preferring to specialise in office organisational problems and their solution by mechanical means.

As secretary or accountant to several organisations successively, he devised and installed accounting machine and punched card systems to give better management information, until war service interrupted this work. In the RASC from 1940–45, he spent most of the war in Africa, and for more than two years of this time he was, as a staff officer, responsible for provisioning and controlling food supplies for Ethiopia and the three Somalilands.

For a short time after the war he was British and American editor of the *Office Machine Manual*, writing much of it himself, and made contact with many pioneers in the computer field, realising the possible application of these machines to office work. He joined the staff of the National Coal Board in 1948, shortly after nationalisation, as a technical specialist on the application of accounting machines, and was appointed Chief Organising Accountant at the beginning of 1954, responsible for advice throughout the industry on accounting systems and methods. Encouraged to develop his ideas on the possible application of computers to large data processing problems, he carried out feasibility studies and evolved the Board's pilot installations which have since proved his theories by successful operation.

Subsequent expansion of these activities has led to recent decisions by the Board to introduce electronic data processing techniques for all major accounting procedures throughout the industry, and this vast development programme has now started.


PHOTO BY COAL NEWS

D. W. Hooper is a well-known public speaker in the field of "commercial" computer applications, both in the U.K. and Europe. He was associated with M. Bridger in launching the first appreciation courses given in this country (at what is now the Northampton College of Advanced Technology in London). He has recently reviewed the work of all computer service bureaux in this country, and presented a paper on his findings at the Electronic Computer Symposium at Olympia on 6 October. He was a founder and first chairman of the London Computer Group, which later merged with others into The British Computer Society; he was the first chairman of Council. He started *The Computer Bulletin* and was a joint editor for three years.

It is of interest that the Society's Council have chosen their new President from the field of commerce and industry to follow such men as Dr. Maurice Wilkes and Dr. Frank Yates, both eminent in the mathematical aspect of computation. It is an acknowledgment of the part that the commercial user now plays in the development of the computing art, and a tribute to the lead being given by large industrial users to the spread of application and technique.

It is also of interest that, just as William Hooper turned, at the age of 40, from the practice of a pharmaceutical chemist to learn electrical engineering, so Dudley Hooper, at the same age, went back to school to learn computer programming the hard way on some of the early machines, thus returning to the field of communications and his family traditions of four generations.

Mr. Hooper lives at Rotherfield in Sussex. His wife is a well-known breeder of Burmese and Siamese cats, with the distinction of exhibiting the winning litter of kittens two years in succession at the National show at Olympia.

COMPUTER COMMENT

IFIPS Committee

The Committee on Standardisation of Terminology and Symbols, of which Mr. G. C. Tootill is Chairman, has appointed Mr. A. R. Wilde, of Computer Technical Services Dept., *Ferranti Ltd.*, West Gorton, Manchester 12, as Secretary.

European IBM 1620 *Users' Association*

It is proposed to form a European 1620 Users' Association, somewhat on the lines of the 1620 Users Group in the USA. The primary purpose of such an association would be exchange of information among users and prospective users of the IBM 1620.

Any one interested is invited to get in touch with Dr. H. Tompa, European Research Associates, 95 rue Gatti de Gamond, Brussels 18, Belgium.

Techniques Modernes de Calcul et Automatique Industrielle

A symposium on the above subject is being organised jointly by the three societies:

- AFRA (Association française de régulation et d'automatisme)
- AICA (Association internationale pour le calcul analogique)
- AFCALTI (Association française de calcul et de traitement de l'information),

and will be held in Paris during the period 28 May to 1 June 1962. Further information can be obtained from the organising committee AFRA, 19 Rue Blanche, Paris IX.

NORD–SAM

A very successful computer conference was held in Oslo during the period 18–22 August 1961. It was attended by about 600 participants from the Scandinavian countries. Most of the contributions were in Scandinavian languages, but there were two lectures in English at the opening session. One was given by Dr. Robinson, President of CEIR and the other by M. V. Wilkes, Director of the University Mathematical Laboratory, Cambridge. The opening session was attended by the Norwegian Minister of Finance. It is a sign of the growing importance of digital computers that a regional congress of this nature should be so well attended.

New Buildings at NPL

The start of work on three important new research buildings at the National Physical Laboratory, Teddington, was formally inaugurated on Monday, 2 October, by Mr. Richard Thompson, Parliamentary Secretary to the Ministry of Works, when he poured the first skip of concrete into a supporting pier of one of the buildings.

The ceremony took place on the site of a new four-storey building for Basic Physics Division. Nearby, work has started on the building for Autonomics Division, and on another part of the Laboratory a Mechanical Working Laboratory is under construction for the Metallurgy Division.

Altogether, these three schemes will cost just over one million pounds and represent the largest block of development at Teddington since the war. The Mechanical Working Laboratory should be ready in December 1962, the Basic Physics Building in February 1963, and Autonomics building in May 1963.

At a press conference following the ceremony, Mr. Richard Thompson gave some details of the design and construction of the buildings, and the Director of NPL, Sir Gordon Sutherland, gave an outline of the research which will be carried out in these buildings.

The research programme of the Autonomics Division is probably the one which is of most interest to members of The British Computer Society. It includes the development of control systems, self-adapting to the nature of the environment, the recognition of printed and written characters; the mechanical translation of scientific Russian into English; and the automatic indexing and retrieving of documents. This means that Autonomics Division is concerned with new fields of application of the techniques of processing information rapidly. For this research and for processing data from experiments in the building, provision has been made for a computer room which will have a specially designed, removable suspended floor for easy access to the electrical services beneath it. No information is available at the moment about the equipment for this room.

Autonomics Division believes that the most fruitful results can be expected from combining the latest knowledge and techniques in physiology, psychology and physical chemistry with those in mathematics, electrical engineering and physics. Animal learning and human perception are examples of processes whose understanding may help towards the evolution of automatic and adaptive control. Nerve behaviour in animals will be studied; the animals being kept on the top floor of the building. This will be fully air-conditioned to provide constant temperature throughout the year. Plenum ventilation will be used and special arrangements have been made to maintain the desired conditions in the event of an electricity supply failure.

Other special features of the building include a silent room on the ground floor, weighing 54 tons, which will be mounted on a separate, resilient foundation. This is virtually a concrete room inside a concrete room so that the inner chamber is completely isolated from outside noise.

Next to this will be a vibration-free room for neurophysiological research on animal vision and hearing which will be screened all round to prevent electrical interference from outside sources, and will have special low sound level ventilation.

A suite of dust-free rooms will also be provided, arranged to give progressive degrees of cleanliness, the cleanest and driest of which will be served by plant capable of providing a dust-free air supply down to 0·1 micron and of maintaining an absolute humidity of 24 grains per pound in the room. A comparatively crude dust-free room in the present buildings recently gave valuable results in research on fine photographic coded scales.

SIGMA

SIGMA (Science in General Management Limited) is a new organisation which has been formed to offer advice on the use of operational research and other statistical techniques in management. Mr. Stafford Beer (formerly with The United Steel Companies Ltd. as head of the Department of Operational Research and Cybernetics) is Managing Director of the new Company. Mr. Roger Eddison (formerly with BISRA and later of NAAFI) is Director of Operations. The head office of SIGMA is at 69 Grosvenor Street, London, W.1.

International Congress of Mathematicians 1962

The next International Congress of Mathematicians will meet in Stockholm from 15–22 August 1962.

All fields of mathematics, including Probability and Mathematical Statistics, Mathematical Physics and Numerical Analysis will be covered. A special section for Education will be organised in collaboration with the International Commission for Mathematical Instruction.

The Secretary's address is Ragnar Thörn, Secretary, International Congress of Mathematicians, Djursholm 1, Sweden.

Discussion Group News

Discussion Group No. 2—General Accounting is temporarily discontinuing activities due to pressure of work on the present active members and notice through the *Bulletin* will be given of resumption as soon as possible.

Discussion Group No. 17—Numerical Analysis. Arrangements have been made for the 1961–2 season, and include the presentation of papers on the subjects of the difference correction method, infinite integrals, eigenvalues of matrices, curve and surface fitting, and ALGOL 60.

ENTER THE TEENAGERS

A Review of the 1961 *Computer Exhibition and Symposium*

This review of the Electronic Computer Exhibition and Symposium has been jointly undertaken. Mr. P. G. Barnes reviews the Symposium and the small computers and data handling equipment at the Exhibition. Mr. R. M. Paine discusses the medium and large computers, high-speed printers and magnetic tape units on show.

In the review no attempt is made to mention all of the equipment displayed under any heading, but rather it is intended to note the variety of equipment and illustrate it with examples.

In the September *Bulletin* and elsewhere in this issue descriptions of the major exhibits on all stands at the Exhibition are printed. Mr. H. W. Gearing, a Vice-President of The Society, and Mr. L. G. Reynolds, both of the Metal Box Company, have prepared a classified table of the equipment shown at the Exhibition. Mr. Gearing and Mr. Reynolds prepared a similar table in 1958 and the figures are compared.

* * *

The Electronic Data Processing Symposium (P. G. Barnes)

"The Ten Year Itch"—so ran the headline of the editorial column in *The Computer Bulletin* of October 1958 in which the first Business Computer Symposium was previewed. It was accepted at the time that computers and the computing art were entering their second decade. The editorial contained the following remarks: "In commercial application it (the computing art) is still immature in many respects; it suffers from many faults of adolescence: limited in outlook, unsophisticated, sometimes naïve, often brash, occasionally boastful."

The 1958 Business Computer Symposium gave a chance to those associated with business computer application to disprove those statements, to share their experiences with others and to show if the British Computing industry had benefited from the unfortunate examples from America which were published at the time. About a hundred computers were then in operation; half were operating on business applications and here was the first chance to give a series of papers on hard computer experience.

In practice did the 1958 Symposium achieve its aim? Re-reading the review by Mr. Hooper and Mr. Gearing in the February–March 1959 *Bulletin* one feels that some of the charges laid in the preview editorial were true. Machines were late on delivery and pre-planning had been inadequate so that not all who spoke at the Symposium could, in the event, speak from experience. Mr. Hooper expected the 1958 Symposium to answer several important questions. In particular "Did the papers, in general, show that computers now at work on commercial problems have advanced beyond the performance of routine functions?" and "Has the introduction of computers been accompanied by any changes in management technique either as a prior requisite or as a consequence?" He found the answer in each case "No."

If the 1958 Symposium did not give all the hoped-for experience it was certainly a success. The latest Symposium must, I feel, be judged against both the background of the previous Symposium and current thinking. Did it answer the questions posed in 1958? Did it answer current problems? Did it pose new problems?

In management and duration the Symposium followed the lines of 1958. There were six sessions of 2¼ hours each during which 27 papers and a brains trust were presented. Papers were circulated to delegates beforehand. As in 1958 the task of collecting papers from the speakers in time for printing was almost impossible and papers were despatched with barely time for them to be read before the first session. This time papers were grouped under session titles: 1958–61, A Review of Progress; Data Processing in Industry and Commerce; Buying Time—Pointing the Way for the Smaller User; New Techniques.

The Symposium itself changed its name from the Business Computer Symposium to The Symposium on Electronic Data Processing. The Society was again represented on its organising committee which was formed by representatives from the EEA and the computer manufacturers. There was a complete absence of rivalry between companies and all worked together to make sure that the Symposium papers represented a useful contribution to knowledge without unnecessary advertising. The theme of the Symposium was User Experience and Technical Advances.

The Symposium opened with an account by Mr. J. D. Janes (*O & M Division, H.M. Treasury*) of the progress made in Government Departments since 1958. Progress was there to be reported, at least in the number of computers in use by the Government. Excluding purely scientific machines this has risen from 7 in 1958 to 18 in 1961. A further 9 are on order. The primary applications are payroll, stock control, accounting and statistics. The Treasury look for direct savings in the introduction of computers. A specimen form

printed in Mr. Janes's paper shows the headings used to break down cost comparisons between manual and automatic methods. The Air Ministry is to enter the field of Data Transmission with a centralised store system and IDP rather than ADP is planned by the Ministry of Works. Nobody could accuse the Government of rushing into projects but here was a report of good solid progress.

Mr. Grant's paper, "The Computer as an Aid to Production Management" was one of the highlights of the 1958 Symposium. Unfortunately Mr. Grant (then of *BTM Co. Ltd.* now *ICT Ltd.*) was indisposed at the last moment and his paper was read by Mr. Gurling (*ICT Ltd.*). The initial computer controlled production system for the *BTM* factory at Letchworth has been working for three years. The merger of *BTM* and *Powers* into *ICT* delayed the introduction of a full system to all factories but this is now under way. By June 1962 all three of the main *ICT* manufacturing groups should be under computer controlled production. An interesting point made in Mr. Grant's paper concerned the relative order of difficulty experienced in introducing a fundamentally new scheme into an existing organisation. Originally the design and construction of the total scheme was considered to be the biggest and most difficult task. The next major task was the actual programming of the computer. The final stage—the introduction of the scheme—seemed relatively easy. Events proved this to be wrong and implementation, with all its personnel problems, was by far the most difficult. The system engineering was next in order of difficulty and the computer programming the simplest and least difficult. The system did alter the various levels of management and it was necessary to be more precise about the definition of function of various management levels. An interesting result of this is that foremen can now devote time to managing their team of men.

The third paper on the first morning was given by Mr. A. Bradley (*Ford Motor Co. Ltd.*). Fords were one of the first to use a computer for a large scale payroll on a service basis. The system has proved a success and Fords are now engaged in transferring the payroll to their own computer. This is an interesting operation which has shown that the growing process of transferring from one machine to the next can be achieved without major mishap. Many other installations will have to face this type of problem in the next few years. Fords obviously have a realistic view of computers for Mr. Bradley warned that the cost of computers and the preparation for them is high. Big staff reductions cannot be expected in these early days and increased costs may often be justified by increased efficiency.

Mr. K. E. Schang (*Trigg-Fylgia Insurance Co.*, Sweden) read, at least for me, the most interesting paper at the 1958 Symposium. This year he came back to tell of his experiences using a computer only two of which were built. Mr. Schang has found the need to have good and persistent programmers. He admitted how little was really known about the computer installation in 1958. "Indeed, we are glad that we did not then know how little we knew, because we should never have ventured to make a start." However, he obviously has faith in computers and he was able to announce the placing of a firm order for another British computer. Mr. N. C. Pollock (*Stewarts & Lloyds Ltd.*) reviewed progress of work and discussed the successful transfer of a complicated bonus system on to a computer. Mr. Pollock bravely attempted to answer the question, "how long will it take to write a programme to do this job?" His answer was to get the estimate of an experienced programmer. He qualified this by explaining the standard practices followed by Stewarts and Lloyds in programming.

Lord Brabazon, in his address at the Opening Luncheon referred to the courage of firms buying computers in 1958. Mr. Brockbank (*Glaxo Laboratories Ltd.*) obviously needed courage to carry him through his troubles of the past three years. The establishment of a computer at Greenford was not without its difficulties, particularly in respect of peripheral equipment. I am sure many firms will benefit from the experiences of Glaxo and, by the new and improved equipment to be seen at the Exhibition, it appears that the manufacturers have already done so.

The final paper in the User Experience session was presented by Mr. R. B. Baggett (*Job White and Sons Ltd.*). In 1958 he made a most useful contribution by describing the use he made of only one or two hours a week hired computer time. He has discovered that by-products of a computer run can become essential parts of the final information. Of interest to the comparatively few women in the audience was his statement that he is using a computer to forecast what dresses they will be wearing next season.

The second day on "Data Processing in Industry and Commerce" was opened by Mr. G. Thomson (*Boots Pure Drug Co. Ltd.*). His paper was really a continuation of the theme of the previous day. Boots have successfully solved a major input problem by the use of mark sensed punched cards. A previous system designed around optical scanning proved too expensive. Careful planning, including the design of special metal holders, has made the mark sensing of all 54 columns reliable. Manuals are an important part of an EDP system and Boots take care to prepare them thoroughly. They write manuals under the following headings, "Method Summary," "Programming," "Operating," "Halt," "Punching" and, the thickest, "Clerical Operations."

Mr. L. Bonney (*Crosse & Blackwell Ltd.*) attempted to define Data Processing and then outlined his company's approach to selecting a computer and system study. For programming staff he felt GCE "A" level Mathematics sufficient if combined with O & M training.

The banks have, naturally, been reluctant to rush in on new and untried techniques. Mr. J. Letham (*Bank of Scotland*) showed that, nevertheless, they are active. The Bank of Scotland is the only bank in Britain operating with central arrangements. They have progressed from a punch card calculator to a full computer and make use of data transmission from branches to the computer. The cheque sorting equipment used is of American design but the data transmission equipment is British.

Direct user experience was left behind with the paper of Mr. F. Knight (*Commercial Union Assurance Co. Ltd.*). His company have ordered a second generation computer, a prototype printer and will use data transmission. A review of his experiences must surely be a subject for any future Symposium.

A highly specialised computer system was described by Mr. V. Bak (*Scandinavian Airways System*). Passenger handling time at Copenhagen airport has been reduced by about ten minutes as a result of the use of an electronic computer. A comparison was made of the cost of a mechanical system against an electronic system. The latter was the most expensive but had so many advantages that it was adopted. An obvious question to ask is what happens when the computer breaks down, especially when one is controlling the movement of passengers. The electronic system was run

in parallel with the old and, once learnt, has proved to be more reliable than the human one. Breakdowns do cause trouble but SAS are confident that the system, which has been working since last summer, will be a success.

The attendance at the fourth session showed where the main interest was in the Symposium. A packed house assembled for the session. What was the interest? "Production" or "Planning" appeared in the titles of all the papers. It is difficult to review these papers as they are detailed descriptions of the jobs the authors propose to do on computers. Three of the papers, those by Mr. W. Kease (*AEI Hotpoint Ltd.*), Mr. F. Stubbs (*AEI Lamp & Light Co. Ltd.*) and Mr. J. Anthill (*Rubery Owen & Co. Ltd.*) may be grouped together. They describe production systems for which second generation computers have been ordered or just delivered, as in the case of Mr. Kease. The full systems are planned to be operative at given times in 1962. The companies have adopted, quite rightly, a cautious approach. I think the best paper to read is Mr. Anthill's. He has benefited from the experience offered by the manufacturers of his chosen computer. There are many tangible and intangibles in data processing and it was encouraging to hear of the support in both areas given to Mr. Anthill by his top management. A steering committee with support from the Board has helped the project from its start.

Mr. D. Bell (*Standard-Triumph International Ltd.*) was able to describe actual experience in the field of stock control and accounting. He outlined the shortcomings of the previous manual system and took them as the basis of requirements for a new computer system. Although still in its first year the system is proving its worth. Inaccuracies from the old system are being brought to light and clerical savings made.

At first sight the paper of Mr. W. Brown (*Shell International Petroleum Co. Ltd.*) did not fit into the sequence of production control set by the other papers. On consideration, however, the implications of this paper, "Commercial planning for an integrated Oil Company," surely come before production control. The latter is the means by which a given company production policy is carried out. The present trend in production control starts by being given a plan, then mechanise the old manual system to carry out the plan. It is true that the manual system is much revised but the computer is used to tackle large amounts of clerical type work; as such great savings can be made and it is a worthwhile process. But who is to say the basic manufacturing plan is good? Mr. Brown's paper discussed some of the planning problems tackled by his company. They require the construction of complex models of the company and all its activities, and large computers are needed for their solution. Such large scale economic problems are a challenge to management, scientists and computer designers.

The morning of the final day was devoted to the smaller user. The audience too was much smaller. This was a pity for the session proved to be interesting. Mr. D. W. Hooper (*National Coal Board*), President of The Society, opened the session with a review of the service work on the manufacturers service computers. Then followed six short papers describing problems tackled on service machines. The use of autocodes for one-off jobs was discussed by Dr. C. Wroth (*G. Maunsell and Partners*) and this was followed by an example of job costing by Mr. G. de Verteuil (*Schlumberger Overseas SA*) planned stock control by Mr. C. Bayliss (*Ever Ready Co. Ltd.*) and inventory control of precious metals by Mr. S. Emery (*Engelhard Industries Ltd.*). "Evaluation of Confidential Materials" was the intriguing title of a paper by Mr. A. Stevenson (*Stevenson and Howell Ltd.*). This described the costing of manufactured items from varying raw material prices. The calculations were previously performed by senior personnel since the recipes of the beverages made by Stevenson and Howell are, naturally, closely guarded secrets. This application arose out of an inquiry made at the 1958 Exhibition. The low cost per run, some £15, surprised Mr. Stevenson. I wonder if there have been inquiries of this kind at this latest Exhibition? Mr. Wormald (*Midlands Electricity Board*) outlined a market survey for consumer electrical goods and then the session took the form of a brains trust. The computer managers of six service bureaux answered questions from the floor of the house. There was an interesting discussion on the form of contact between the service computer and the user. The question of system analyst/computer programmer can be a difficulty within a company. At a service bureau a much wider variety of job is tackled and the bureau can hardly be expected to have experts available on all subjects it tackles. Mr. Bagshaw (*Ferranti Ltd.*) used the expression "link man." This man has a broad background of problems, a sound knowledge of his computer and the personality to deal with customers. Anyone offering service is at the receiving end of criticism. The managers spoke out about their problems which are often not realised by customers. Customers without their own equipment do not always understand the difficulties involved in what seems to them minor alterations in work. There was no hint of advertising by any firm and there were plenty of questions.

At this time it is perhaps appropriate to say something about the procedure for asking questions both at the Brains Trust and throughout the Symposium. Last time written questions were accepted but, in general, questions were put from microphones placed in the aisles. This time special forms were placed on every seat before each session. Stewardesses collected the written questions and took them to the chairman. Spared the embarrassment of public-speaking delegates asked many questions. These were, on the whole, well thought out and raised useful points. However, too many were asked in each session for replies to be given at the time. Written replies will be sent to all whose questions could not be answered and they will appear in the formal transcript of the Proceedings. The volume of written questions effectively stopped contributions from the floor so that there was little spontaneous discussion. Perhaps this was as well for the audience wanted to ask questions rather than have discussions. This reflects on the nature of the audience. I feel, though I have no quantitive evidence, that last time there were more than a few senior management present but this time the audience was composed of people who have actually to carry out the job rather than lay down policy. Certainly it was an international audience with visitors from France, Germany, Holland, USA, Russia, Japan, Brazil and other countries.

The final session was called "New Techniques." Dr. Gill (*Ferranti Ltd.*) opened it with a paper on the "Place of the Programmer" in which he reviewed the present work of the computer programmer and what the future holds for him. By the use of analogies (music, hair driers, bacon slicers and lawn mowers) he skilfully took the audience through the various levels of programming and automatic programming languages. Dr. Gill ended on a sad note. "Ten years ago this country led the world in computers. Since then we have fallen sadly behind the USA . . . our programmers are fewer and have been too much concerned with making the best use

of several different small computers. Most of the new programming techniques now come from the USA." I believe Dr. Gill is right, but the British with their traditional compromise solutions have much to offer programmers and programming techniques. The USA programming techniques, whilst admirable and in advance of our own, lack flexibility. We must develop automatic languages which offer the programmer the same flexibility as the basic order code of the machine. I feel that the basic code of current British machines are superior to their American counterparts.

The penultimate paper was presented by Dr. Clows and Mr. Parks (*NPL*). This was a review of character recognition and the techniques used. They felt the long-term solution to the problems lay in the development of optical readers (see Mr. Thompson's paper) which require the machine to conform to the man rather than the reverse.

Dr. A. Douglas (*C-E-I-R* (*UK*) *Ltd.*) ended the session with a review of new techniques both hardware and software. (I believe he was the first and only person to use "software.") He returned to the theme of computers in policy making and said computers could not make policy decisions but they could provide valuable aid to management in its main role of policy making. He saw the need for extension of data collection systems such as character recognition and data transmission to speed the flow of data to a computing system. Here was one session where discussion, rather than questions would have been valuable. Perhaps something really new would then have come out of the session for it produced little which was not already known.

What of the Symposium as a whole? At the beginning I quoted some questions asked by Mr. Hooper about the 1958 Symposium. I think the answers to them must still be a qualified "No." Would we have been right, however, to have expected it to be "Yes" at the present stage of development? If three years ago we entered our second decade we now enter the awkward teenage. The Symposium came before the introduction of new equipment built on the experience of the old and we have not as yet all the techniques to carry out to the full the implications of the second question. Mr. Brown in his paper showed the way medium fast present-day computers such as Mercury and 7090 help management in economic policy making.

If we had the milli-microsecond machines, with suitable peripheral equipment freely available, could we use them *now* on business applications? We complain today because our teenagers have devices capable of a "ton" and do not know how to handle them. I suggest we must continue to go through the hard learning process of introducing computers to take over manual systems. We must make full use of the experiences offered in the earlier papers and develop the larger, more elaborate, but still only improved manual methods described in the later papers. It is from these methods after all that the information is derived for future planning. A large planning programme requires reliable input data and usually this can only be supplied by a computer system taking over the clerical functions. One speaker referred to the errors found in a manual system after takeover by a computer. Confident though we may be of success I feel we must get more experience of the ability of computers to handle accurately large volumes of data under widely different conditions. Several speakers showed that computers can do this. Mr. Grant pointed out the human difficulties involved in implementing a computer system and several of the systems we heard about have to go through this stage. Thus on balance I feel that it would not be right to have expected a "Yes" to the questions. However, if I may make a forecast I am sure that by the next (if any) Symposium we will have success stories from those firms who, today, are starting to actually introduce ADP into their organisations with second generation computers.

As a comment on the present situation I feel that the papers presented a reasonably good picture. Some of the current problems such as selecting staff with suitable background and selecting computers themselves were dealt with.

As for the future, at least as discussed at the Symposium, I am not so happy. Teenagers should be asking awkward and embarrassing questions. The Symposium did not really cover awkward areas. Where do the techniques of data transmission and character recognition fit into the computer picture? What will be the real effect of COBOL, ALGOL, and other automatic languages on the work of computer staff such as system analysts and programmers? What will be the effect of integrated data processing on clerks, foremen, managers and other workers? What is the future place of the computer itself within an organisation?

To sum up I consider the Symposium achieved its main aim to present user experience. It did not present enough new ideas or attempt to answer the really awkward questions of the future. It laid further very necessary foundations to the computing art but did not point the way to new methods of construction.

A final word must be said in thanks to the Chairmen for controlling the very tight schedule of each session, to the Organisers of the Symposium, who put in a great deal of work and to the companies who willingly allowed their staff to speak so frankly of their experience in the computer fields.

Computer Exhibition (R. M. Paine)

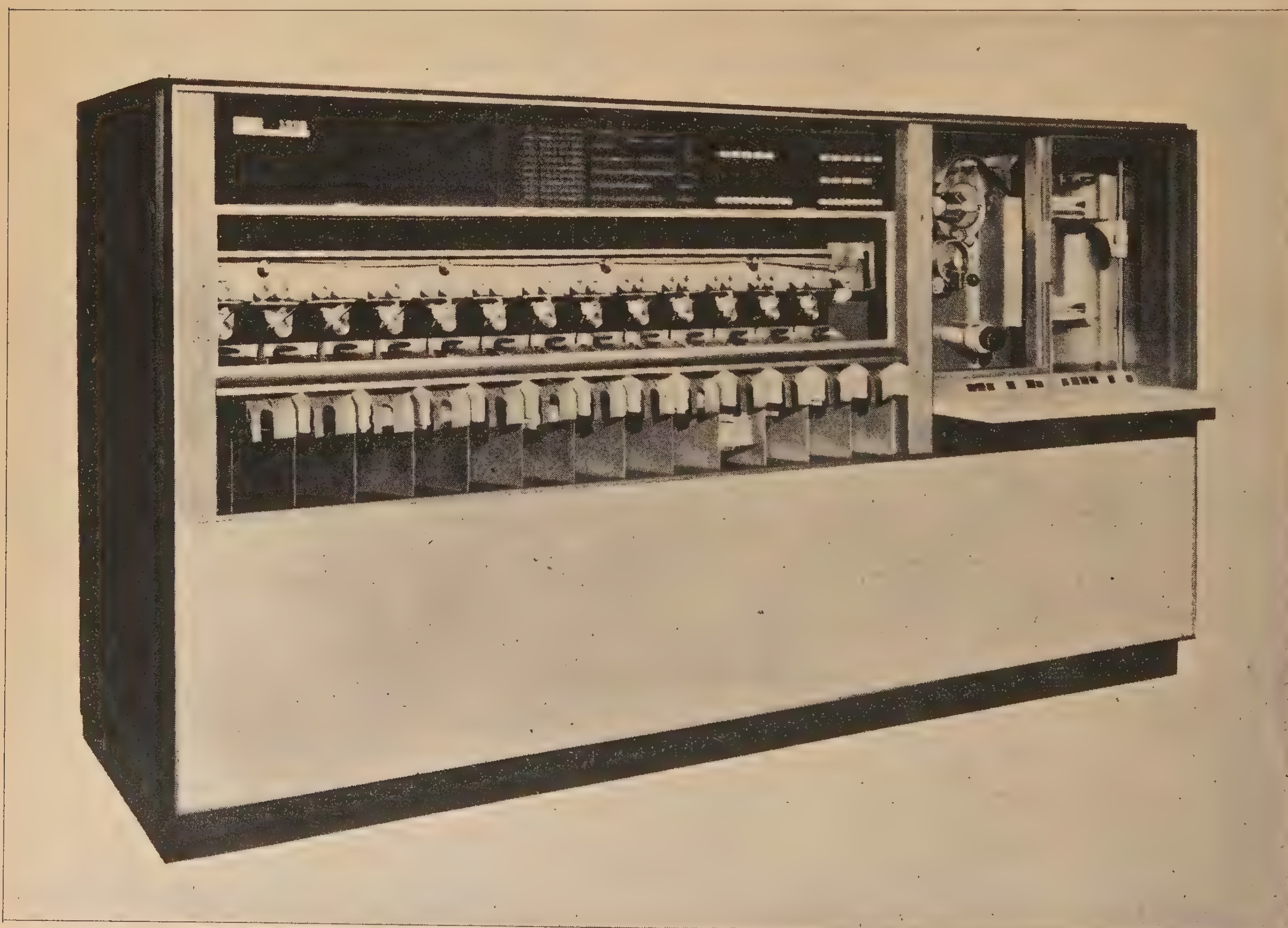
I visited the Computer Exhibition after seeing several episodes of the BBC TV science-fiction serial "A for Andromeda." In this play messages sent out from Andromeda, 200 light years away, are interpreted by a scientist on earth as a code for building an advanced computer—the code was in binary of course! The computer, when built, frightens its earth designer in its power and possibilities, and proceeds to print formulae to produce life on this planet. This life can directly communicate with the computer without need of character recognition, punched cards, printed output, etc., by means of electrical currents from the brain, and proceeds to attempt to take control of humans. The operators do not even know if they can stop the machine, i.e. by pulling the electrical plugs out! I, therefore, visited the Exhibition with some anxiety and trepidation.

I found none of these fears present on the stands, nor any of the above advances in computer communication or computer design. True the astronomical displays on the Ferranti stand for ORION looked very much like the TV picture of the constellation Andromeda, and some of the equipment on the *IBM* and *ICT* stands looked remarkably similar to some of the components of the TV computer.

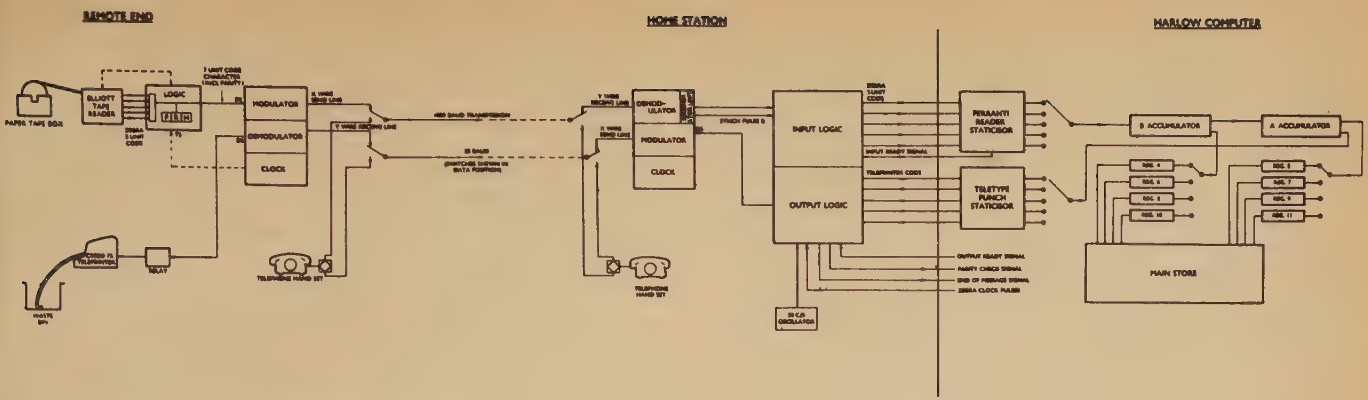
However, the Exhibition if not living up to the standards of science fiction was lively enough and bore evidence to the progress of computer and ancillary equipment firms in the last few years. The computer is certainly not yet using and controlling man. Let us consider the computers that were on show at Olympia.

Medium to Large Computers

Some computers were too large to show on the stands, or required special air-conditioning or their installation period was too long to get ready in time for the exhibition. This is, of course, one drawback of an exhibition, and a prospective buyer should not shop solely from those machines on view. However, there were enough medium to large computers present to keep visitors extremely busy in order to cover them all. What can be gained by seeing a computer in action? Not very much for in the latest models there are hardly any flashing lights, though I suppose the speed of paper moving



IBM 1210 Cheque Sorter



Standard Telephone System Data Transmission between Exhibition and Harlow

through the printer proves the machine is alive. Perhaps it is the desire to make sure the computer really does exist and work; at least one manufacturer must have been aware of this since he advertised on the general theme, "come and see a computer actually working." Showing computers in the flesh is rather like holing short putts at golf—your opponent of course knows you can do it, but he would rather you did it than concede you the shot—who knows you might miss!

The AEI 1010 made its London début and had linked to it the XERONIC printer and 6 magnetic tape units and card reader. This complex made it probably the most costly exhibit on view, and it seemed to be working very well with many people crowding the stand to see it in action. The 1010 shared time between an invoicing operation and card to MT operation—a fairly simple case of time-sharing according to the theorists, but probably the first display of time-sharing in a British exhibition.

The EMI 1100 which has of course been working well for a long time was in an exhibition for the first time. It performed a variety of jobs but being roped off it seemed rather detached from the spectators—who, as I have indicated above, probably learnt more anyway from the accompanying film of computer applications than actually seeing the machine.

The ICT CARD 1301 formed an attractive and informative exhibit—it certainly looked well styled, compact and new—much more a piece of business equipment than an extension of the laboratory into the office. *ICT* with three computers on view—the 1301 and the 1202, and at the BEE the 558, certainly proved their wide coverage of the business market. The 558 computer for 40 column cards, shown for the first time to the public, was a very interesting machine and should prove useful for the small firm—it aroused such interest abroad that it was taken to the Paris exhibition before the close of the BEE and latecomers saw only three empty frameworks where the system had stood—but plenty of literature was available.

The IBM 1401 was again on show this time linked up to a 1405 RAMAC store of 20 million digits—which reveals how well *IBM* design their various pieces of equipment so as to link up together in many combinations. The 1412/1210 cheque reader and sorter described below can also be linked up to a 1401 or 1410 computer, thus forming a system which can perform a lot of work at medium speed, or prepare data for input to a large computer.

Standard Telephones and Cables Ltd. were showing a STANTEC computing system, and illustrated the range of their computing activities by their airline seat reservation system designed in Germany. The keysets used for interrogating the magnetic drum computer looked easy to operate, informative and neat—and emphasised how much such a system relies on good input/output equipment. There was a ticket desk on the stand where one could communicate with the SAS seat reservation system in Copenhagen, but since this meant actually buying a ticket on a particular plane I did not test its capabilities.

With all the agreements and rumours of agreements I looked forward to seeing an *RCA* computer on several stands, but I had to be content with illustrations and components.

The "teenagers" mentioned by Mr. Barnes in his Symposium review, were certainly growing up and, as teenagers do, improving their appearance by such means as lipstick and better clothes—in other words the external styling of many computers was much better with cabinets and consoles simple to look at, less jutting edges and protruding shapes, and occasionally the various units blending in with each other so that no longer did all computer installations look like a haul of a rag and bone man. Colours were most varied and had escaped from a uniform of greyish green. The lounges on stands were larger and more comfortable, and the seats softer and more abundant—an indication perhaps that people were expected to be able to sit and discuss problems rather than just gawk at hardware.

High-Speed Printers

Many high-speed printers were in operation and aroused considerable interest. It was notable that many firms were offering different speeds of printing for numeric and alphanumeric characters—because of the different ways of grouping the character set around the barrel or chain of the printer. If only numeric printing is required the set of characters is reduced and thus can be repeated around the barrel or chain so that more than one line can be printed per revolution as long as the paper can be moved fast enough. Perhaps computer users will invent a new standard English which reduces the number of letters in the alphabet and uses octal or binary numeric notation, in order to obtain faster printing speeds.

The *Anelex* printers on the *Leo* and *EMI* stands seemed to be working quite happily and efficiently. With up to 160 positions across the paper and using up to 6 part paper speeds of 500 lines per minute for full alphanumeric characters and 1,000 lines for numeric characters, were claimed. The printer on the *Leo* stand was said to be operating at 880 lines per minute and the quality of print produced was very good. *Anelex* also produce another version of their printer which operates twice as fast.

The *RCA* designed off line printer working from magnetic tape, which forms part of the *English Electric* KDP 10 and KDF 9 system, looked a field-proven piece of equipment, that had several facilities with it that would be very useful to a programmer or operator. The printer operated at 600 alphanumeric lines a minute or 900 numeric lines a minute and the printed characters were very clear (as a gimmick it also printed at 1,350 lines a minute—but with the same character all along the line). The "editor" part of this printer allows certain control symbols included in the magnetic tape information to select which lines should be printed—only certain classes will be printed in one run, other classes being ignored. Thus a tape can be produced holding several types of output each of which requires printing on a different form. This method, which has been used elsewhere of course, would reduce the number of tape units required and the amount of paper changing.

The *Rank* XERONIC printer was one of the stars of the exhibition and with its ability to print up to 4,700 characters a second (about 3,000 lines a minute) on blank paper and simultaneously printing the form background, it attracted many onlookers. There was no evidence of fork-lift trucks around but the bulky cylinder of paper showed how rapidly the machine produced printed results. Since its price was more than most of the computers on show it is no wonder that it is being used for special applications such as insurance billing where a high rate of printing is really essential. For management information purposes a slower printer is surely adequate—otherwise management will not be able to read, let alone act on all the reports produced.

The *National Cash Register* stand featured a high-speed printer, similar to the printer which will be fitted to the 315 system, and which has already been installed in Britain on earlier *National-Elliott* computers. It operated at 680 alphanumeric or 900 numeric lines a minute, and seemed a good engineered piece of equipment. From the ranks of the printers mentioned above and others such as the ICT 1301 or the IBM 1403, most users should be able to choose a printer suitable for their needs.

Magnetic Tape Units

Magnetic tape units are now firmly established at British installations and in some are treated as familiarly as punched cards, without the special reverence and care that seemed to be necessary a few years ago. There were several to be seen at Olympia and the majority were very similar in claimed performance. The AMPEX TM 2 tape handler—a transistorised development of the FR 300—was being shown on the LEO stand providing the data for the *Anelex* printer. The unit displayed was ½ in. wide operating at 45,000 characters a second. but wider tape with more tracks is offered at 90,000 characters a second. *ICT*, *Ferranti*, *EMI*, *AEI* and other manufacturers are also using or planning to use AMPEX tape decks which look as if they have become the most widespread in use with British computer manufacturers.

IBM have of course their own magnetic tape units and there are probably more of these in the world than any other type, but this year they were not showing any new tape units and in this review we are concentrating on new equipment.

Decca were showing their latest magnetic tape transport the Type 4000, which is said to have a speed range of from 45,000 to 180,000 characters per second. *Decca* are one of the few British firms to successfully develop magnetic tape units but it must be recorded that the majority of tape units in Britain today are of American design and will continue to be for the next few years. *Data Recording Instrument Co.*—also a British firm—were exhibiting their latest tape transport, and attention should be paid to their developments since they are an associate company of *ICT* who will have a demand for large numbers of tape transports in the future. *Data Recording Instrument* also had a useful machine on the stand to test tapes and make sure they were of the high quality necessary for use in computer installations.

One type of tape unit new to Britain was the FACIT ECM 64 shown on the *AEI* stand. This is more commonly known as the "Carousel" memory and has been working in Sweden for about two years under test conditions. 64 tape reels are located in a ring, each reel holding about 30 ft of tape. When a particular reel is addressed the ring rotates until the required reel reaches the operating position, where the reel is unwound and reading or writing takes place. The average access time for a block of information is about 2 seconds, and the unit can hold about 3 million alphanumeric characters.

In addition, *RCA* magnetic tape units, now manufactured at Kidsgrove, were working on the *English Electric* stand; *National-Elliott* had film units attached to the 803; and *Standard Telephones* were using their 100 metre continuous loop magnetic tape—so again plenty of choice was offered to users.

General Comments

One of the best and most impressive exhibits was the IBM 1412 cheque reader/sorter which read magnetic characters in the E.13B code printed on cheques of all sizes and thickness, and sorted them into sequence, at the rate of 950 document passages a minute. It could not only sort the cheques, but transfer the information read from them direct into the 1400 or 7000 series of computers. Nine of these machines have already been ordered by British banks. The machine seemed very easy to load even when in operation and must be the forerunner to the document handling and character recognition machines of the future—when perhaps the rows of punched-card operators will not be so vital to computers. What would happen now to data processing installations if punched card operators went on strike!

The Managing Director of *De la Rue Bull Machines*, Mr. J. G. Barnes, is reported to have said, "This is the first time that my company has exhibited and I have been enthused by the interest that we have aroused." British business men were anxious to see what the off-shoot of the French company had to offer and hence the activity on the stand. The 300 DP Series was of interest as a step between steam punched card machines and a full computer system. The 300 Series looked very flexible and offered a good speed of printing—300 lines a minute—for the small or medium-size application. After this exhibition *De la Rue Bull* can be considered as part of the British scene and not just a new interloper from the Continent.

In contrast to *Bull*, not all exhibitors would agree that the exhibition was worthwhile. One manufacturer's spokesman said to the *Electronics Weekly*, "I would like to see this the last exhibition—but you must remember that my view is coloured by the knowledge of how much all this costs a firm to promote, and it seems doubtful whether a good return will result from the effort!" Another firm's representative also doubted the wisdom of a computer exhibition for he felt the BEE should be the place to show commercial systems, and that mathematical and scientific machines could be

shown and described at scientific meetings and conferences. Presumably these would mean in the main at The Society and University meetings.

From the point of view of a user it is probably quite useful to see all the equipment in one place; but really it is only the man with a casual interest who has not seen or heard of the items beforehand at manufacturers' factories, data centres, meetings or in magazines. It might be useful, however, for sales and prestige abroad to show the size and strength of the computer industry.

Computer Exhibition (*P. G. Barnes*)

Small Computers

A firm with anything from £6,000 to £30,000 to spend on computers would have had a good choice at the Exhibition. Very broadly the small machines can be classified into

(*a*) teaching machines
(*b*) business machines for invoicing, ledger printing, etc.
(*c*) general purpose on/off line machines.

As a rough guide I would put the first category as under £10,000, with the others up to £20,000 and £30,000 respectively.

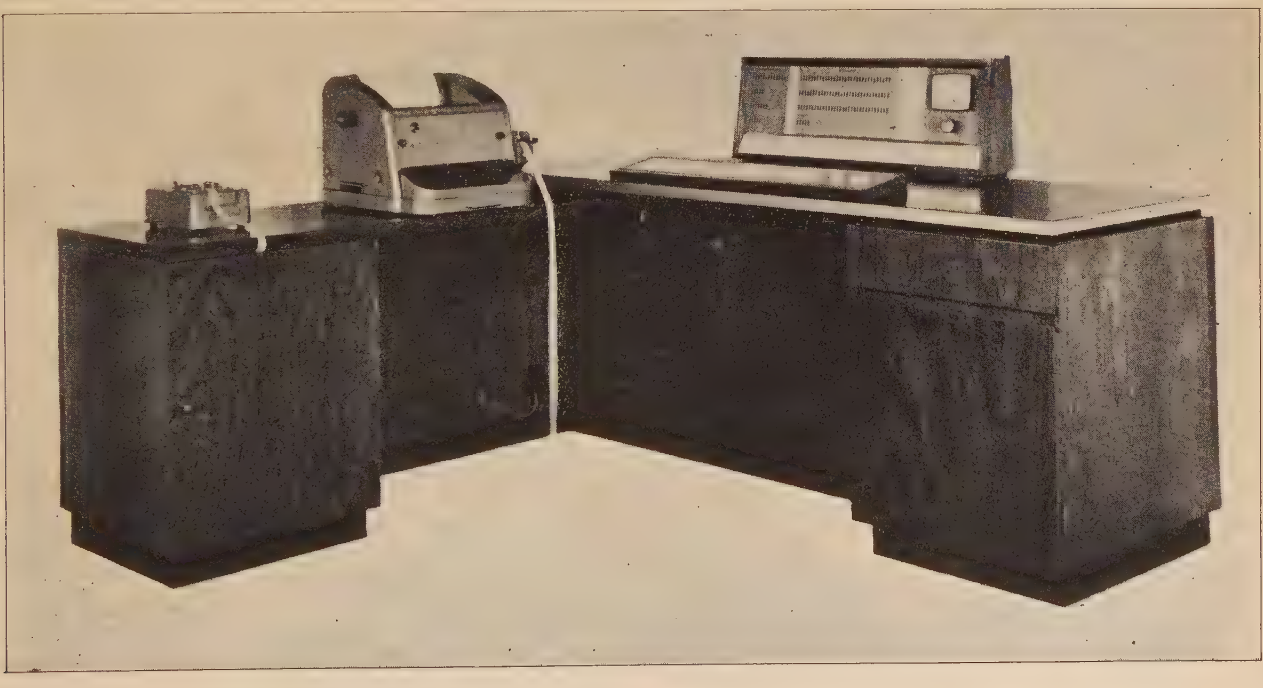
Of interest especially in teaching was the Computer Engineering 100 series of computers. The *CE* computers are general purpose machines with a single address code and one accumulator. Every address can be modified. The CE 102 is specially designed for the technical college. Indeed, the machine could be built in the college laboratory for the design is based on the NHECTA1, developed by the North Herts. College of Technology. Reading the specification of the CE 102 is rather like reading a specification of a machine in 1956. Has it a place in 1961? Yes, I firmly believe that students should be taught on a basic machine—such as the CE 102—free from autocode (though in fact it is big enough to enable it to accept an autocode). The CE 102 is about £8,500 basic and the CE 101 with smaller store £6,000.

In the same field *Armstrong Whitworth*, a member of the Hawker Siddeley Group, have produced an educational computer. This is a relay machine using standard post office relays and uniselectors. It has extensive display facilities and programmed multiplication. This is intentional for the manufacturers feel that students must be aware of the processes carried out within a digital computer, a very sensible approach, especially for mathematicians and future computer engineers. It was encouraging to see at least two training computers in the Exhibition.

A slightly more expensive machine—about £12,500 basic is the MONROBOT MARK XI. On show at the BEE it can have up to three separate input and three separate output devices which can be plugged into the computer and operated simultaneously. *Monro* aim to make the machine operable by anyone who can type.

Block and Anderson showed the small CLARY DE 60 computer and also their BANDATRONIC sterling calculator. The BANDATRONIC combines the flexibility of a typewriter with the power of a calculator. The typist types in the normal way until a calculation is necessary: she then enters the numbers and waits for the machine to type the answer. One calculating unit can serve six typewriters and costs £6,000 with one typewriter; each additional typewriter unit is £2,250. The CLARY DE 60 computer comes in two models—a desk machine and the DE 60M which is on castors and can be rolled around and plugged in any electric point. Perhaps this will lead to a computer break, when harassed scientists can make use of a trolley computing service!

NCR showed their 390 computer, a small machine for the business user. The machine accepts and outputs magnetic card ledger records. These are record cards with magnetic strips on the back and their use represents another solution



The C.E. 102 Computer

to the data originating problem. Paper tape was used as a storage medium and also as input/output. VERDAN (*Versatile Differential Analyser*) on the same stand, was perhaps the smallest of the small computers—weighing 82 lb. It has three computational centres—a differential analyser, a whole value or general purpose centre and link input/output centre. It has a disc memory capable of withstanding 15*g* and in the event of power failure it "freezes" the computation in its current state. It is of use in missile and other airborne applications. VERDAN was one of five Elliott computers working on the *Elliot NCR* stand—the others were 803's working on a variety of jobs both on and off line.

The manufacturers' description of most of these machines starts with the words "a small general purpose computer." Some of the machines are more general purpose than others. One of these is the *English Electric* KDN 2. It is designed around the DATAPAC elements which are used in special purpose computers. Whilst it is a computer in its own right *English Electric* also offer it as a service machine to a larger installation, converting data in various forms to magnetic tape. KDN 2 can also operate in real time applications.

To me, the number of small computers and the range of jobs they were tackling was a feature of the exhibition. Apart from the economic benefits of these small computers for firms who cannot afford larger machines, there is surely a place for them beside and serving a large, fast computer. There will not be many large, fast computers around the country. Such as there are may well be linked to many computer service users. If this is the case it is my view that the service user of a big machine will need a small machine of his own. There is a lot to be said for having a small computer available on demand rather than waiting for time on a large, remote computer.

Paper Tape

There was much to see at the exhibition for the paper tape enthusiast. Almost all machines offer paper tape input/output, especially the smaller ones. 7 or 8 channel tape is favoured. There were many card to paper tape converters to be seen and paper tape punches connected to accounting machines to produce a tape record as a by-product.

Creeds demonstrated a paper tape store at the centre of an electromagnetic data processing system. This has developed from the DORIS system. The store is a reel of paper tape which is searched whilst passing at 60 m.p.h. When the selected item is reached it is output to the required station where it is printed under a stored programme control. Its cost is around £6,000. The model 3000 punch was demonstrated and *Creeds* are aiming to attain an error rate of 1 in 10 million. This is made possible by a check back device which photoelectrically reads the codes after punching. Also on the *Creed* stand was the production model of the 1000 output printer working at 100 characters per second.

On the *NCR* stand the 390 system had a paper tape storage device which looked remarkably like a magnetic tape unit.

The possibilities of paper tape both as a storage medium and as a common language medium, coupled with its economics were well demonstrated at the Exhibition.

Data Preparation Equipment

Under this heading I group machines which do more than just punch data on the cards or paper tape. Their development seems to fall into three classes:

1. Equipment which prepares interpreted punched cards for use as original documents and computer input.
2. Equipment which produces paper tape or cards as a by-product of another operation. This class may be subdivided into machines which do or do not transmit information to a control point.
3. Equipment which reads original documents and converts them to computer input. The reading processes may be divided into:
   - 3.1 Hole sensing either mechanically or photoelectrically.
   - 3.2 Magnetic ink.
   - 3.3 Optical scanning of coded information.
   - 3.4 Optical scanning of legible information.

Throughout I use the word "legible" to mean information presented in standard English characters. Coded information, on the other hand, is not normally readable except by machine.

Account Tokens Ltd. exhibited their PRINTAPUNCH. This falls into my first class of equipment. Basically master information is prepared on a plate which is inserted into the PRINTAPUNCH. Variable information is added from a keyboard and all the information is printed and punched on the card. A PRINTAPUNCH costs £122.

A whole range of accounting and adding machines fall into class two. Paper tape and punched card producing machines were about equally represented. *British Olivetti* deserve mention here for presenting a complete system of accounting machine to paper tape or punched cards, cards to paper tape and finally paper tape to magnetic tape. Thus from one firm all equipment to prepare magnetic tape for a service computer could be obtained.

Frieden showed their COLLECTADATA system, which merged information from paper tape, edge punched cards, standard cards or keyboard and transmitted it to a central point where it was recorded at a rate of 15 characters per second on paper tape. Information from a central clock could also be recorded at the same time.

The PRINTAPUNCH and COLLECTADATA systems are designed for the collection of production type statistics, i.e. Job No., Man No., etc., are regarded as master information; time on, time off, number of parts made, etc., as variable information to be keyed in at the time the information is recorded.

The simplest system in my third class was shown on the *Leo* stand and in its own right at the BEE. The Kimball tag uses both print and micro-punched holes on a small tag. Special machines print, number and punch the tags which are then attached to articles. When the article is, for example, sold the tag is detached and returned to a central point where it can be automatically read and its information put on to punched cards. I was impressed by the ability of the reading machine to read quite badly damaged tags.

A more elaborate system of document handling but still based on punched holes was shown by *Original Document Processing*. Information is punched on to documents either in a legible hole code or a standard binary code. The documents can be circulated in the normal way and can be written on and stamped as necessary. On return they can be sorted and read on to punched cards for computer input. The equipment allows additional data to be added to the punched card from a keyboard if necessary. As demonstrated the equipment effectively dealt with multilated documents which must surely be the acid test of all original document handling equipment. The cost of a whole system is between £13,000 and £17,000. As already mentioned by Mr. Paine, a magnetic ink sorter, the IBM 1412 was shown,

and I fully endorse his remarks about it. Magnetic sorters are naturally more expensive than photoelectric sorters, possibly by as much as five times.

Continuing my examples of the types of equipment on show, I go to the BEE where Ferranti-Packhard exhibited a compromise solution to the problem of originating data. They use plain cards which have normal typewriting on one side. On the other side there is a code system of small bars of ordinary ink, the presence or absence of bars denoting specific characters. The method of preparing the cards is in two stages. First the card is typed in the normal way and simultaneously a paper tape is prepared. The card is then reversed and inserted in a special typewriter operated by the paper tape, which prints the ink lines. Subsequently cards can be manually selected by plain language description and then a transactor reads the coded language, puts it on paper tape and allows manual insertion of variable data.

The *Solartron* ERA was not on show at the exhibition. Optical scanning of legible information formed a subject in the "New Techniques" session at the Symposium. Perhaps by the next exhibition, if any, we will see a working machine, but I doubt if one is shown, that it will be more than a prototype.

So much for the equipment on show. There were not many examples of widespread use of original document processing in this country either at the Exhibition or the Symposium. The equipment is there but like many computer projects it must wait for the systems work to give it a full trial before it is fully accepted.

A piece of equipment which does not strictly fall into any of my definitions but which I feel may be of interest was shown at the BEE. The *Bradma* productograph is another answer to the data origination/collection problem. This is designed to deal with control of machine tools or production line processes. Each machine tool or point on a production line is connected to the central machine. One part of the central unit is a mechanical gant chart on which is set the time allowed for each machine group. A linear scale is then automatically advanced as progress is signalled from the outstations. Should the machine tool or production line stop for any reason a warning light is operated. In addition to the visual display all the data is recorded in graphical form. Although as shown it had no connection with a computer it could obviously be used to drive tape or card punches so that simultaneous visual and computer records could be made. The cost is of the order £12,000 to control 20 machine groups.

Data Transmission

The GPO claim to have £1,000 million worth of equipment available in the UK for transmitting information to computers. Most of this, of course, is tied up in telephone and telex lines. The GPO showed a prototype error-detecting device for use on the telex system. This is based on a magnetic drum store which holds the transmitted information until the correct signal is transmitted back to it.

The transmission rates over telex and telephone lines were discussed at The Society's Symposium on Data Transmission last March. Some of the equipment described then was on show. Data transmission is in some ways a good subject for an exhibition—the exhibition stand being linked, say, to a factory computer.

Standard Telephones demonstrated their transmission system by connecting their stand with a ZEBRA computer at Harlow, some thirty miles away. Data was transmitted from the stand at 1,000 bauds, processed by the computer and sent back at 50 bauds. A comprehensive error detection system is used and the system retransmits in the event of error.

ATE exhibited punched paper tape input/output data transmission links between their stand and three other stands at the exhibition. This was working at 150 characters per second.

IBM offered card to card, magnetic tape to magnetic tape and a receiving system which allows a 1401 computer to be linked to any of their range of transmitting devices.

Hawker Siddeley Aviation showed the "Data Link" system, which is mainly intended for remote control of plant equipment. Both digital and analogue signals can be transmitted.

All the systems relied on error detection rather than error correction, and the fastest one worked at about 150 characters a second over private speech lines. I would have liked to have seen error correction being demonstrated. Exactly how this could be done I do not know but spurious signals could be inserted at one end and the correcting equipment could be shown producing the right signals at the other.

The main comment on data transmission must be that users are still not coming forward. Firms are waiting and watching others. For £6,000, a small sum compared with a computer, a data link at about 150 characters per second could be established over an existing private speech line. If no private line is available the GPO rent lines and a booklet gives rental prices. The GPO and equipment manufacturers are there and willing to help. Potential users please note.

General Remarks

Mr. Paine makes some remarks about the value of showing large computers at an exhibition. Whilst this is a question for debate I feel it is certainly useful to see the smaller items grouped under one roof. One can then wander from stand to stand comparing equipment. It may well be, of course, that the right place for the equipment I have discussed is at the BEE Exhibition. Personally I found more of interest in the ancillary equipment than in the large computers on show and I think the manufacturers of this small equipment are to be congratulated on their efforts. From their point of view I am sure the Exhibition was a success.

* * *

Joint Conclusions

Whatever the advantages and disadvantages of having an exhibition at the present time it is useful as a milestone to review the progress, if any, that has been made since the last Exhibition. Lord Brabazon, opening the Exhibition said: "We have fallen behind America and the continent of Europe not in making computers but in selling them." Dr. Gill, at the Symposium, said we had fallen behind in programming techniques. This is not a happy picture, if it is true. In some ways the computer industry resembles the aircraft industry of a few years ago. Then there were ten or so firms making aircraft, and charges such as "you can make good aircraft but not sell them" were being made. The aircraft industry then, as now, relied on home sales to

provide a basic order from which to start production before it could compete for export. The aircraft industries' answer, with Government encouragement, was to merge into two large groups and diversify its activities.

Dr. B. V. Bowden, Principal of The Manchester College of Science and Technology, in the course of his talk "The Impact of Automation" to The British Association for the Advancement of Science, declared: "Computers can be very expensive—a big machine costs more than a jet airliner, and it can be much more important to the national economy. The American Government has developed both aircraft and computers with the same enthusiasm. We seem willing to support our aircraft industry and help it make jet airlines to compete . . . , but we have made totally inadequate provision to develop our computer industry on a similar basis." He also said that in 1957 the Government spent more on the egg subsidy than it gave to the University Grants Committee—a peculiar sense of values.

In 1958 there was much speculation about possible mergers in the computer world. There have been mergers but there are still some ten major computer firms at the moment.

Looking round the Exhibition one had the feeling that the manufacturers ought to consider mergers. Second generation machines are with us and few manufacturers can offer a complete computer service with a range of machines. Several large manufacturers still have to rely on input or output equipment made by their apparent rivals. The development of anything to do with computers, mechanical, electronic or software costs a great deal of money. Only very large firms can maintain the research staff necessary to keep abreast of developments, and the production staff to quickly turn new ideas into working systems. Can the industry and the country as a whole waste what money it has in maintaining ten separate systems? We hesitate to suggest a pattern but perhaps two major groups each with a business and scientific division would cover the general purpose computers, with a separate group to cover the special purpose on line machines. The Government should also give greater direct help and guidance as it has done in the aircraft industry, and as the American Government has done by development contracts in their computer industry.

Was the Exhibition as a whole a success? Only the manufacturers can quantitively assess it by their order books. Certainly by their different ways of exhibiting their major equipment either by showing it, by televising it on closed circuit TV from the factory or by having comfortable lounges to sit and talk about equipment and problems, they will have evidence to show which is the best way to display their wares. Many visitors to the Exhibition both from manufacturers and users made the comment "nothing really new." This coupled with the remarks of Lord Brabazon and Dr. Gill, must give us all a warning. Let us deliver the goods, perhaps talk less about them and concentrate on obtaining wide experience. We suggest this will see our teenagers safely through to maturity.

Programming and Control Languages

The following course of 12 lectures, which is being planned at the London School of Economics for the Lent and Summer terms, might of interest to programmers in general.

Introduction. Assemblers, Compilers and Monitor Systems.

Assembly Programs. The SHARE assembly program for the IBM 7090 (FAP).

Assembly, Loading and Subroutine Linkage. FAP subroutine linkage. The FORTRAN BSS loader. The M.I.T. linking loader. SQUOZE.

Extended Assembly Language. Macro instructions. Conditional assembly. Assembly time computation. The use of macros for symbol manipulation.

Recursion. Nested Macros. Recursion. Recursive definition of enumerable classes.

FORTRAN. Arithmetic Statements. Subroutine Linkage. In-Out Statements.

Algol and FORTRAN. Basic Algol. The relation between Algol and FORTRAN.

Control Languages. The FORTRAN Monitor System (FMS). The Bell Telephone Laboratory Monitor System (BTL). The MUSP Statistical System. The LP 90 Linear Programming System. Relation between control language and programming language.

Time Sharing. Basic Concepts. Time sharing hardware of the IBM 7090, the RCA 601, the Burroughs B5000, the IBM 7030 (Stretch) and the Ferranti ATLAS. Basic Control language vocabulary.

List Processing Languages. Basic ideas of list processing. Trie (retrieval) memory. The LISP language.

Language Translation. Syntax, semantics and metalanguage. Artificial language translation. Natural language translation. The FOMIT language.

Future Trends. Characteristics of an ideal programming-system. Artificial intelligence. Man computer symbiosis.

It is tentatively suggested that the course be given on Tuesdays from 5–6.30 p.m. either on a weekly or on a fortnightly basis. If there is sufficient active interest, a series of seminars on some of the topics mentioned could be held in parallel with the lectures.

Anyone interested in attending the lectures, or anyone who has any comments regarding the syllabus, should write to Peter Wegner, Research Techniques Division, London School of Economics, Houghton Street, London, W.C.2.

COMPLETION OF RECORD OF EQUIPMENT AT THE ELECTRONIC COMPUTER EXHIBITION, OCTOBER 1961

In *The Computer Bulletin* for September 1961, page 79, there appeared a preview of part, compiled by an Associate Editor from notices received; we expressed regret that some of the biggest exhibitors had not been able to send us their notices before the date of going to press. All the stands were visited during the Exhibition and these brief notes are an attempt to complete the record begun in the September issue, by covering the significant additional items which we saw. Further details may be obtained from manufacturers direct, and all details should be checked with them.

The table summarises our impressions of this Exhibition.

Additional copies of The Computer Bulletin 5/2 may be obtained price 5/– post free, on application, cash with order, to the Society's office.

Stand 1. The Solartron Electronic Group Ltd.

Additional to the items on page 79, this company also exhibited a radar trainer on which the movement of several aircraft could be simulated, a process response analyser, a digital clock and printed-circuit testing equipment.

Stand 5. Block and Anderson Ltd.

The Clary DE60 digital computer (18 decimal digits and sign, 20 registers, drum, plugboard program 120 steps) was demonstrated on this stand.

Stand 8. Ferranti Ltd.

The Sirius computer was available for service work as well as giving demonstrations. The Ferranti-Packard document transcriber, data originator and table look-up machine were located in the neighbouring Business Efficiency Exhibition until 11 October. An ingenious flow chart invited visitors to the lounge to discuss their computing problems.

Stand 11. IBM United Kingdom Ltd.

The 1620 data processing system was available for service work with Fortran, etc. Another major exhibit was the 1412/1210 magnetic-character cheque reader and sorter (950 documents per minute).

Stand 12. Hawker Siddeley Group Ltd.

This Group includes Armstrong Whitworth Equipment of Gloucester, A. V. Roe Ltd., Armstrong Whitworth of Baginton, Coventry and Blackburn Electrical. Exhibits included data acquisition devices and transmission equipment, a digital differential analyser, an 8-bit analogue-to-digital converter, an AVRO educational computer and an Airbric incremental computer.

Stand 15. Associated Electrical Industries Ltd.

This Company exhibited an AEI 1010 digital computer with six magnetic tape units, a Xeronic printer and card reader. The computer shared time between an invoicing operation (MT and Xeronic) and a card to MT operation.

Stand 16. Short Brothers and Harland Ltd.

The Short Nuclear Reactor Simulator (¼ scale model) was on view, also a new analogue computer developed for educational purposes and the Short Control System Analyser.

Stand 19. Automatic Telephone and Electric Co. Ltd.

The data-transmission links were connected to the stands of EMI, English Electric and Leo.

Stand 21. International Computers and Tabulators Ltd.

The type 1301 electronic data processing system was exhibited working on an invoicing application. This equipment included the new *ICT* punched-card input system (600 cards per minute) and line printer (600 lines per minute).

A type 1202 computer with conventional card reader and tabulator form of printer was also in operation.

Displays included the Rapidwrite system of autocoding, notes on the British Aluminium Company's data collection system supplied by *ICT*, and details of *ICT* training schemes for users staffs.

In the adjoining Business Efficiency Exhibition, *ICT* displayed 80 column automatic key-punches based on the original Powers-Samas design, and a 40-column (round hole) electronic calculator (ICT 558) with stored-program of up to 256 steps.

Stand 30. Southern Instruments Ltd.

This exhibit included a new 12 channel compact motorised trace reader, a 6-channel recorder and various other instruments having outputs which could be fed into a computer.

Stand 33. MSS Recording Co. Ltd.

Flux-sensitive heads for reading from slow moving magnetic tape were featured, together with several grades of magnetic tape.

Stand 36. EMI Sales and Service Ltd.

Information was available here about "Emitape," an instrumentation tape made at Hayes originally for video recording and further developed for digital computer applications.

Stand 37. Data Recording Instrument Co. Ltd.

This Company was exhibiting their latest high-speed digital tape transports programmed to simulate actual operating conditions. Important characteristics of this equipment are: a start/stop time of two milliseconds; packing density of 300 upwards bits per inch; special dual read/write heads with 0·39 in. separation between write/read gaps; "fail safe" operation on all important functions; and complete air filtering and pressurised cabinets.

The Tapetester, model 536, was also shown. This equipment has been developed to assist manufacturers and users in evaluating the quality of magnetic tape in the face of an ever-increasing demand for higher packing densities and greater accuracy. Having been in the forefront of many of today's achievements in the field of magnetic recording, Data Recording Instrument Co. claim they are the first in Britain to present this latest piece of equipment.

A full range of magnetic recording heads was also shown.

Stand 43. Leo Computers Ltd.

Leo exhibited a Kimball Tag to 7 channel (BSI) paper tape converter, with inbuilt parity checking, which had been developed for the work of stock control, etc., in a chain of retail clothing shops. Invitations to visit Leo installations were issued and appointments arranged.

Stand 44. The Plessey Co. Ltd.

The Company's latest developments in "Ferramic" square-loop cores and assemblies were displayed, providing a complete range of memory systems for individual computer manufacturers. Test equipment for core-matrices was also shown. Digital data-link equipment with loop-error detection equipment, for use on telegraph circuits, was also shown.

Semiconductors Ltd. showed a selection of transistors designed for specific functions in computers, etc., and a very complete data book on these was issued to inquirers.

Stand 47. Mullard Ltd.

Mullards Semiconductor Division were showing a full range of transistors, diodes and rectifiers, and also issued a designers' reference book, quoting basic parameters.

A range of Core Storage Matrices were also exhibited, the cores being of "Ferroxcube" material.

Stand 50. The British Computer Society

We exhibited specimen publications and extracts from papers together with a sketch-map of the British Isles, on which were plotted the branches and the location of the Society's honorary officers. Visitors to the stand included men from Australia, Southern Rhodesia, Canada, Eire, USA, France, Netherlands, Germany, Switzerland, Portugal, Czechoslovakia, Russia, Japan, China and other countries.

Over 40 new members were recruited. Special attention was given to all students visiting the stand. One college party was conducted round the Exhibition by a Committee member on duty.

The help of many honorary officers throughout the Exhibition; of Miss Mollie Barnes in arranging the furniture and flowers décor; of Mr. G. A. Firth as interpreter; of Mr. S. A. Tasker and the office staff, is gratefully acknowledged by the BCS Exhibition Committee.

Stand 51. Computer Engineering Ltd.

This Company, of Stranraer House, Stoney Road, Bracknell, Berks., exhibited their CE 102 computer, costing about £8,500, with 4,096 words (32 bits) drum store. The design is based on the NHECTA 1 machine built at Letchworth College of Technology: it was expected that a similar computer would be delivered shortly to a technical college in Surrey.

The CE 102 has been designed to satisfy the demand from technical colleges for a machine whose price is lower than that of machines currently offered for sale. Consequently, programming, control and display features have been designed largely with the lecturer's needs in mind. Programming features of the machine include unconditional "jumps" to another part of the program; "jumps," or transfers, conditional on the sign of some predetermined number; ease of re-entry to a program after the transfer out; address modification of instructions by the machine ("B-lines")—all of these are usually accomplished by means of a single instruction. Each instruction is of the single-address type, and the program can be advanced step-by-step from the control panel.

The operating cycle time is such as to give an addition time of 0·612 milliseconds and a multiplication time of 10 milliseconds. Since the elements of the machine are transistorised there are no serious cooling problems. Input is by means of five channel punched paper tape, and output is via a teleprinter with a built-in paper tape perforator.

Stand 52. Elliott-Automation Group

A new model of the Elliott card reader having hopper capacity for 2,000 cards and a tray receiver of similar capacity with a further development in column identification was exhibited.

A paper-tape reader working at 200 characters per second for data transmission input was also shown.

The new stepping card reader, sending signals to an Addo-X listing machine, provided the possibility of an inexpensive prelisting operation where cards were to be punched in decentralised locations (cost approximately £1,300).

Stand 53. Account-Tokens Ltd.

Account-Tokens Ltd., who are specialists in the utilisation of the plastic card for credit control systems, and in the manufacture of equipment for imprinting credit sales bills to provide accurate recording of customer data, have now obtained exclusive distribution of a new range of source data punching equipment.

The equipment, known as Print-A-Punch, is the first equipment available which will enable cards to be punched automatically as a result of recording data in respect of an operation or transaction. Data, such as account number, part number, or operator number are embossed and punched into a plastic plate. Data on plastic plates can be punched into cards ensuring an accurate recording without risk of operator errors. Variable data can be set up on a slide keyboard and recorded into the same punched card. Thus Print-A-Punch will produce punched cards ready for computer input at the point where such data are created.

A small card punch, with interpretative printing into an 80 column card, was also exhibited, to work off a small electricity power plug (230 volt) or delivery-van battery (12 volt).

Stand 54. George Anson and Co. Ltd.

This Company exhibited prepunched-card storage cabinets and paper-tape stoiage, where the operator could sit down while at work surrounded by an ingenious array of storage devices, bringing many thousand cards, etc., within arms reach.

Stand 56. Lintronic Ltd.

On this stand were shown specimen recorders giving up to 10 readings per second from between 12 and 200 channels. A paper-tape reader (35 channel, extendable) was also shown, also a digital clock, and a paper-tape winder (up to 1 in. wide), electrically driven, which spooled up the tape beginning at the outside coil to avoid the need for rewinding before playback.

* * *

Variety of Equipment at the two Electronic Computer Exhibitions—Olympia, London

	OCTOBER 1961		DECEMBER 1958	
	WORKING	MAJOR ASSEMBLIES	WORKING	MAJOR ASSEMBLIES
Types of digital computer:				
(*a*) In exhibition—				
Business data processing systems	8	3	5	4
Scientific computers	8	7	7	1
(*b*) Available for service in London—				
Business data processing systems	6	—	2	—
Scientific computers	7	—	1	—
(*c*) Models on show (or details available)—				
Business systems	—	5	—	6
Scientific computers	—	5	—	1
Types of analogue computer	9	—	9	—
Types of electronic calculator (including BEE)	6	—	3	—
Data-collection and preparation devices	49	—	17	4
Computer input devices	24	—	8	7
Output devices:				
Printers	13	—	15	—
Punches	6	—	4	3
Chart drawing	8	—	3	—
Paper-handling devices (output)	13	—	10	—
Magnetic-tape units	6	5	4	8
Brands of magnetic tape	—	4	—	2
Core-storage assemblies	5	6	2	3
Magnetic drums	7	8	11	4
Types of data transmission equipment	16	—	3	—
Training devices	6	—	$\geqslant 2$	—

No type of equipment is counted twice, unless used for both input and output, even if it appeared several times. Thus, the computers available for service in London are those not exhibited at Olympia (e.g. Leo II, IBM 7090 and Mercury).

Members' Handbook

Next spring the Society is to issue a Handbook which will contain essential information about the Society and include an alphabetical list of members.

The attention of Members is drawn to the Handbook Questionnaire sent out with the latest issue of the *Computer Journal*, Vol. 4/3.

Members who have not already done so are asked to complete the questionnaire and return it to The Assistant Secretary, The British Computer Society, Finsbury Court, Finsbury Pavement, London, E.C.2, as soon as possible.

Members not returning completed questionnaires risk the inclusion of obsolete information about themselves in the Handbook. Any member who has not received a questionnaire should contact the Assistant Secretary immediately.

DATA TRANSMISSION FOR MULTIPLE SHOPS

Introduction

The British Computer Society set up a Committee to consider the subject of data transmission in December, 1960. The members of the Committee are as follows:

R. G. Dowse, F.C.A. (*Chairman*).
P. G. Barnes, B.Sc.
L. R. Crawley, M.S.I.E.
G. Dale.
M. E. Drummond, Junr., M.A., B.S.
P. A. Long (resigned 24 January 1961).
R. H. Tizard, B.A., M.I.E.E.
D. R. Turner, M.Eng., M.I.E.E.
A. S. Waller.
J. T. Whittaker.

The terms of reference of the Committee are as follows:

(1) To study the progress made in the field of data transmission and to report on it from time to time.
(2) To make contact with potential users and their trade associations:
  (*a*) to ascertain the demand for transmission facilities and the specifications required to meet the needs;
  (*b*) with a view to discussing the standardisation of requirements.
(3) To promote interest in this field by collaboration with other committees of the Society in the dissemination of information on developments.

Multiple Shops Federation

It was decided to approach the Multiple Shops Federation with a view to discussions, and a joint meeting was held, attended by the following gentlemen from the MSF:

J. C. Butler	Director, Multiple Shops Federation.
E. D. Mort	Multiple Shops Federation.
H. Kavanagh	Littlewoods Mail Order Stores.
B. T. Ramm	J. Sainsbury Ltd.
C. Warburton	Montague Burton Ltd.
W. Smith	W. H. Smith and Son Ltd.
P. T. Sauvarin	W. H. Smith and Son Ltd.
J. Greenhill	Dorothy Perkins Ltd.

A multiple trader is officially defined as a retail concern operating ten or more branches; however, many of the members of the Federation operate several hundred branches throughout the country, and there are a few chains of over 1,000 branches. The purpose of the discussions was to ascertain:

(*a*) the extent of the interest in the subject;
(*b*) the nature of the information which is transmitted between retail branches and the central points;
(*c*) the possibility of data from branches being in one of two or even more categories in respect of urgency which would necessitate the use of different methods of transmission;
(*d*) the flow of information with particular reference to urgency of data and peak periods;
(*e*) the signalling rates required with reference to categories of data;
(*f*) the degree of accuracy;
(*g*) the possibility of collaboration between traders in the sharing of facilities;
(*h*) the type of equipment suitable for use by retail staff for transmission;
(*i*) the price levels for equipment which could be justified economically both for independent operation and for participation in shared facilities.

General Matters Affecting the Operation of Multiple Trading

Although there are many common problems, the methods of operation vary considerably according to the nature of the trade. Probably the most significant variation is in the method of replenishment of goods.

In some trades, the local branch manager decides what goods are required. This may be done within the framework of a predetermined standard stock which is expressed either in money or in units. Alternatively an overall financial standard may be set for the branch, probably in absolute terms or on a flexible budget geared to the turnover. Whatever framework is set, the essential point in this system is that the manager decides precisely what goods are to be ordered.

In distinction from the previous system, the goods to be supplied to a branch are decided by an outside authority, e.g. the Head Office, Area Inspector, Central Warehouse, etc. Again the deciding authority may be constrained to work within a budget.

The primary difference in these two methods from a data processing standpoint is in the type of the information supplied by the branch to the central authority. If the branch manager orders his own goods, he only needs to send a list of his requirements in order to be replenished. Indeed, if replenishment is obtained direct from an outside supplier and not through a central warehouse, it may not be necessary in all cases even to advise the central authority of the orders placed. However, in those cases where the central authority makes the decision, it would be necessary for the branch to submit detailed lists of its stock position. Such a system is usually adopted in fashion goods where the central buyer is probably better informed on fashion changes and where there are a number of effective substitutes for any item which is out of stock in the central warehouse.

A second major difference in the data processing approach arises from the problems of obtaining an analysis of the sales. Articles of low value usually have a high rate of sale in terms of the number of transactions per hour. The lower the value and the higher the rate of sale, the more difficult it becomes to keep records of each transaction. Conversely, the sale of an article of high value is usually conducted at a more leisurely pace and hence there is time to record data relating to that transaction. Where a unit document is prepared for each transaction, dissection of such documents provides sales analysis information. Where such an approach is not possible, the sales can only be deduced from the opening and

closing counter stocks, but in many trades because of the number of lines, the physical problem of recording makes this an impractical proposition. In such cases, the central authority's guide to the sales of individual lines is restricted to an examination of the branch requests for replenishment without regard to changes in the volume of branch stocks.

It was generally agreed by the representatives of the Multiple Traders that it was only in respect of stock and sales that a desire for more rapid methods of data transmission is likely to arise. Other types of data, e.g. payroll, were discussed but it was felt that existing postal transmission is adequate.

Benefits Arising from More Rapid Transmission

The prime investment of a multiple trader is in stock-in-trade and his first consideration is to see that the branches are adequately stocked at the most economical level. To this end rapid replenishment as sales take place is essential. In some trades, by reason of sizes and colours, the number of items stocked by a branch in one colour—size—style tends to be quite small and rapid replacement of a missing size or colour in a given style is essential if customers are not to be disappointed.

It was generally agreed that the object of speeding up transmission and processing of data was primarily to achieve a more satisfactory rate of stock-turn in the branches, coupled with adequate replacement of goods which are sold. Anything that can be done to shorten the interval between the sale of goods and replenishment of the branch would contribute to overall efficiency.

It was, however, emphasised that the benefits which might arise from more rapid receipt of information must be weighed against the costs of the equipment involved. Although no definite conclusions could be established, thought must be given to such considerations as the smaller branch where cash registers and in some cases even telephones are not available and, alternatively, the number of points of sale in large branches where the pressure of work at peak trading times would require the provision of many units of equipment if the data is to be created at the time of sale.

Data Creation

All the members of the multiple trades emphasised that the core of the problem lay in data creation. Under present conditions the preparation of returns to the central office absorbs far more time in the branch than the time taken to transmit by post. It was agreed that it was vital to reduce the amount of time spent by branch staff on clerical work. In general, until an adequate means of producing data at the branch in a form acceptable to a machine can be found which is both cheap and accurate, there seems little point in pursuing the question of faster means of transmission.

Data Creation Equipment

Several attempts have been made to provide equipment suitable for use by retail traders which would provide a machine language output as a result of sales recording. The most common of these methods is the use of punched paper tape in which the sale is recorded in five channel code. Such equipment has tended to be highly priced and has hence met with a minimum amount of success either in this country or in the United States. A further disadvantage is the length of time it takes to record the sale to get the necessary data into the tape to make analysis possible and it is only the ability to provide analysis which makes such equipment worthwhile from the trader's point of view.

Another approach is to have a code printed tally roll which, like the paper tape, records the sale in coded form to be subsequently read by a suitable reader to provide statistical analysis. This equipment is also highly priced which tends to militate against its use.

Volume of Data

The volume of information to be despatched depends upon the system of replenishment. Although no definite conclusion could be reached, an example may be of value. In a chain of over 200 branches, if details of the sales were to be transmitted daily, the peak load might be 2,500 digits per branch per day for Saturday's trade and the minimum might be 500 digits per day for the slack days of the week. This gives a peak receipt at the centre of 500,000 digits from 200 points in one day. The same chain, if details of the stock position were to be transmitted, would have a load of 25,000 digits per branch and if the stock position for each branch was transmitted once a week only, just before replenishment day, the daily load of receipts at the centre would be 1,000,000 digits (25,000 digits per branch for 40 branches per day). If, however, the manager ordered his own goods, the load might be 4,000 digits per branch per week which spread evenly over the week is 160,000 digits received at the centre each day.

It will be seen that the same business has a requirement varying from 100,000 digits per day received at the centre to 1,000,000 digits per day, depending upon the system of replenishment and control.

Shared Facilities

Consideration was given to a proposal to establish a data transmission centre in each shopping area under the control of a neutral agency, such as a bank or post office. The object of this proposal is to provide data transmission facilities to all multiple traders in the shopping area and provide cheaper transmission through shared facilities. It was recognised that data brought to such a centre would have to be either in a form suitable for direct entry into transmitting equipment (i.e. punch cards, punch tape, etc.) or it would be in the form of manually written documents which would then be transmitted by keyboard operators at the transmission centre. If the centre is to be supplied with information in a form acceptable to machines, this again raises the whole question of data creation referred to above.

Degree of Accuracy

The degree of accuracy required depends on the nature of the information transmitted. If the branch is sending information of its sales or its future requirements, an error leading to the replacement of a wrong item or quantity would not lead to any serious consequences in most trades, especially if checks for reasonableness can be applied. If, however, information on stock levels is transmitted, an error in a style number may cause more widespread trouble.

A discussion was held on the degree of accuracy required in transmission. No definite conclusions were reached, but the experience of one member using the existing Telex service

indicated that the current error rate of one in forty thousand was not unreasonable.

Conclusion

It was generally agreed that until suitable methods of data creation had been invented, there is unlikely to be any demand for data transmission facilities by members of the multiple trades.

Data Transmission Committee

The Data Transmission Committee would be very interested to hear from any members who have experience of data transmission, and who would be prepared to write a short account of their work in this field.

Details should be sent to R. G. Dowse, 7–13, Great Dover Street, London, S.E.1.

COMPUTER INSTALLATIONS

Mr. A. B. Frielink of Amsterdam has provided an interesting table of computer installations with the following comments. But do our readers agree with his conclusions?

Sources

Number of computers installed and on order as per 31 December 1960: private documentation of one of the leading computer manufacturers.

Total population: Statistisches Jahrbuch für die Bundesrepublik Deutschland 1960; Demographic year-book 1959 UN.

Percentage working population: Statistisches Jahrbuch für die Bundesrepublik Deutschland 1960.

Percentage working in agriculture and fishery: Estimates from the most recent national censuses.

Concept of Computer

The concept of computer is not well defined. Very small-scale electronic systems or calculators (such as Bull Gama 3, *IBM* 604, 626, 628) are not included. Not included also are special purpose miniaturised computers for space-ships, etc. There is consistency between the different countries as to what is called a computer. Computers are counted without regard to their use (technical, mathematical, business, universities, etc.).

Conclusions

From the last row of figures it seems justified to conclude that

(*a*) two countries (Sweden and Switzerland) stand on a high level and even are accelerating their automation (on order is about twice the number installed);

(*b*) four other countries (Belgium, Germany, Netherlands, France) have reached a level, that is a little bit higher than just half of the former two. Germany is accelerating faster than the other three, at the same rate (about twice) as Sweden and Switzerland;

(*c*) the next three countries (Norway, Great Britain, Italy) are at a level less than half that of the topmost two. In this group Norway has a very high acceleration factor (three times), while on the contrary the United Kingdom is decelerating rapidly;

(*d*) other countries hardly get into the picture;

(*e*) if the number of inhabitants of a country is an acceptable measure, it would seem from the USA figures, that in all European countries a very large market for computers is still open.

Number of Computers installed and on order at 31 December 1960

COUNTRY	ABSOLUTE NUMBER			PER ONE MILLION TOTAL POPULATION			PER ONE MILLION WORKING POPULATION			PER ONE MILLION WORKING, EXCLUDING AGRICULTURE, ETC.		
	INST.	ORDER	TOTAL	INST.	ORDER	TOTAL	INST.	ORDER	TOTAL	INST.	ORDER	TOTAL
Sweden	37	84	121	5	11	16	11	25	37	14	32	47
Switzerland ..	31	62	93	6	12	18	13	26	39	15	31	47
Belgium	37	49	86	4	5	9	10	14	24	12	16	28
W. Germany ..	190	400	590	4	8	11	7	16	23	9	19	27
Netherlands ..	40	51	91	4	4	8	10	12	22	12	15	27
France	166	224	390	4	5	9	8	11	19	11	15	26
Norway	5	17	22	1	5	6	3	11	15	5	15	20
Great Britain ..	240	160	400	5	3	8	10	7	17	10	7	17
Italy	89	167	256	2	3	5	4	8	12	6	11	17
Austria	12	18	30	2	3	4	3	5	8	5	8	13
Others*	23	82	105	•	1	2	1	3	4	2	6	8
W. Europe ..	870	1,314	2,184	3	4	7	7	10	16	9	13	21
USA	12,378	7,843	20,221	70·0	44·2	114·2	172·0	109·0	281·0	196·2	123·8	320·0

* Including: Spain, Portugal, Greece, Denmark, Finland, Eire, Luxemburg, Iceland. • = less than unity.

CHOOSING YOUR COMPUTER

*By P. G. Barnes**

Introduction

This article discusses some of the ways of comparing computer equipment of different manufacturers to find the best suited for a given application. It is not an article on how to conduct a feasibility study. It assumes that this has been done and goes on from that point until the placing—or otherwise—of an order for a computer.

In making this assumption, however, a word must be said about the composition of a computer feasibility study team. An ideal team consists of specialists from each area of work—say Production Control, Accounting, Inventory Control, together with Organisation and Methods and Data Processing men. A team of this construction is able to deal with both system and data processing problems. Such a team creates within an organisation a body of men able to understand the problems of introducing computers into everyday work and the "you" used in this article means the team. A good study team enables the company to retain the initiative in dealing with "experts" from manufacturers and consultants!

A computer feasibility study should give:

(1) A list of jobs to be tackled and a flow chart of how they fit together.
(2) The approximate volume of data and frequency of processing for each job.
(3) First estimates of savings both tangible and intangible which can be credited to the computer to offset its likely cost.

Generally speaking the tangible savings (savings in numbers of staff and money) are few. The intangibles—better and quicker flow of information, better staff relations and so on—will probably form the basis of the case for the computer.

If the feasibility study shows a computer to be worthwhile then one must know in detail how much it will cost to buy and operate to offset against the expected savings.

Financial Outlay

Computers come in all sizes and in price from about £20,000 to over a million pounds. A rough break down in price is as follows, in terms of capital cost:

UNDER £100,000	£100,000–£250,000	£250,000–
Small scientific machines and punched card computers.	Magnetic tape computers with four or five units. High speed input and output. Medium calculating speed.	Large fast computers. Ten or more magnetic tape units. Random access units, enquiry stations, etc.

* Formerly of *de Havilland Aircraft Co. Ltd.*, now with *C-E-I-R (U.K.) Ltd.*

Most machines can be rented. Terms are of the order of 30 % to 33% for a minimum rental of 3½ years. Rental usually includes maintenance and is for single shift operation. Manufacturers may agree to lower yearly terms over five or even seven years. The first estimates of savings will give some idea of the possible price range. However, it is necessary to get an estimate of the volume of work for the computer and the time a given machine will take to process it before deciding which machine to buy.

A small punch card computer at say £80,000 may look attractive but the load on it, when fully estimated, may be over two shifts and some of the advantages in having quick information from the computer may be lost. Magnetic tape may be needed taking the cost into the next price range. Alternatively an expensive computer may only use all its features for a small percentage of its time so that a small machine with some inconvenience may be economic.

Performance

How do you really estimate the performance of a given computer? Computing speed, input speed, magnetic tape speed—all these are quoted by the manufacturers. Will the machine, however, process your cards at 800 a minute? Or will it be 600? What size store do you need? How many tape units? Any drum or random access units? A computer must be compared against *your* jobs to *your* specifications. The manufacturers will do this for you but you must first describe the jobs you want to do and supply them with facts and figures.

This can be done by issuing a job specification and sending it to your manufacturers. A suggested form that the specification may take it as follows:

Divide the job into three sections and decide units for each section.

1. *Input*	1.1	Raw data for punching in decimal characters.
	1.2	Master files if used as input—number of characters in one record and number of records.
2. *Calculation*	2.1	A rough idea of the volume of calculation, e.g. 6 multiplications, 12 additions per unit of input data.
	2.2	Master files for processing—number of characters per record and number of records.
3. *Output*	3.1	As data for subsequent computer runs—number of characters.
	3.2	Reports for printing—number of lines of print.

To this information must be added the frequency of the run, i.e. daily, weekly, monthly.

It is useful to have a standard form for a job specification which can be completed by your own system study team.

JOB NO.	DESCRIPTION	FREQUENCY	INPUT	CALCULATION	OUTPUT	COMMENTS
1.	Weekly payroll, 3,000 staff. Includes analysis of final deductions.	Weekly on Mondays.	75 characters per person. Punched from clock cards.	Approximately 12 multiplications. 24 additions. Refers to master file 200 characters per record in file.	2 lines of 80 characters each per man. Add 10% for summaries.	Must be run between 3 p.m. and 8 p.m. Mondays.
2.	Financial stock control.	Daily.	2,000 items of 30 characters each in random sequence. Punched from G.R.N.'s or requisitions.	Run against master file of 30,000 items. Each item 250 characters long. 2 comparisons. 3 additions, 1 multiplication.	Estimated one line of print for each item out of stock—say 5%.	
		Monthly.		Run of master file.	List of all items whose price changed by 10%. Say 20% of items.	Possible additional monthly analysis needed.
		Yearly.			List all stock numbers and price.	

Fig. 1.—Information given by Study Team.

An example is shown in Fig. 1. Information in this form does not replace information on any flow charts which may have been prepared. It is a tabulation of the flow chart runs in convenient form for computer estimation. It is important that *quantitive* information should be given, even if it is only approximate.

From the given facts the computer manufacturer should be able to estimate the size and loading of suitable computers in his range. He should reply in the same way as the information is presented. (See Fig. 2.)

Presented in this way the manufacturers can show the estimated loading on all the equipment suggested by them. (See Fig. 3.)

The loading of auxiliary equipment such as sorters, collators, tabulators, reproducers, interpreters, should be itemised. The number of magnetic tape units suggested should be broken down to show the use of 1, 2, 3, 4, etc., tape units. This loading will enable you to see if extra units are necessary over and above the maximum number used by the computer. Present-day computers are less ready-made and more tailored to the job and it is essential to break down the loadings into small units. Core storage is expensive—an extra 4,000 words above the standard size may add £20,000 to the bill.

The loading figures will enable you to see, when plotted against cost, how much you pay for a given loading. Fig. 4 is a typical chart. Machine A has a forecast load of over

JOB NO.	DESCRIPTION	FREQUENCY	PUNCH AND VERIFY	COMPUTER	AUXILIARY EXCHANGE	NO. OF TAPE UNITS REQUIRED	COMMENTS
1.	Staff payroll, 3,000 employees.	Weekly.	20 man-hours.				
	Main payroll.			25 minutes.	1 hour sorter.	4	Will easily fit into Monday loading.
	Summaries.			15 minutes.		2	
2.	Financial stock control.	Daily.	20 man-hours.	45 minutes.	3 hour sorter.	2	
		Monthly.	—	15 minutes.		2	Monthly run may be separate or included in a longer weekly run. This would use an extra tape unit.
		Yearly.	100 man-hours.	5 hours.	10 hour sorter.	2	

Fig. 2.—Computer Loadings Estimated by Manufacturer.

	PUNCHING AND AUXILIARY	MAIN COMPUTER	TAPE UNITS IN USE (HOURS)					CORE STORE. APPROX. NO. OF WORDS USED (HOURS)	
			1	2	3	4	5	UP TO 4,000	UP TO 8,000
Weekly.	Punch and verify 200 man-hours week. Sorter 20 hours. Collater 3 hours. Interpreter 10 hours. Reproducer 15 hours.	28 hours week.	24	24	20	10	—	28	16
Monthly. Additional. Load.	Punch and verify 25 man-hours. Sorter 10 hours.	5 hours.	5	5	5	5	—	5	5
Yearly. Additional. Load.	Punch and verify 200 man-hours. Sorter 60 hours. Reproducer 15 hours.	20 hours.	15	15	15	5	—	15	3

Fig. 3.—*Summary of Equipment Loadings for Machine ABC* 234.

one shift per week (one shift is usually 40 hours which includes maintenance time). Machine D with a loading of 5 hours a week is underworked, but some of its features, say fast calculating speeds, may be needed for one job. B and C with loadings of 28 and 16 hours a week look reasonable figures to work on. Remember these are estimated loadings made, perhaps, two years before delivery of the machine!

Comparison of machines in this way is an over-simplification but it does give some idea of cost per hour to run the machine.

Service Bureaux

At this stage it is worthwhile to investigate the use of service computers. Consultants and manufacturers sell computer time on an hourly basis. Thus it is possible to have access to a much larger computer for short periods of time without the need to have it underworked on jobs which could well be tackled on smaller machines. For example, the machine A in Fig. 4 may serve 90% of the work in well under one shift. The other 10% is stretching its capabilities. The same argument applies to peak loads at end of year or month, which could be off-loaded to a service computer. The cost of service machine time varies from £20 per hour for small computers, around £40 per hour for machines of the IBM 1401 type, to over £200 for the largest machines.

Specific Facts

Cost, however, is not the only point to consider. Many indirect features must be considered. The following is a list which is by no means complete, of points to investigate:

1. Price of installation.
2. Delivery dates.
3. Loading of equipment.
4. Reliability of computer: machines are often ordered long before the prototype is working. The manufacturer's reputation is important.
5. Service facilities in district.
6. Standing-by facilities—other similar machines for emergency use.
7. Expansion potential of system.
8. Continuity of machine series, as say—IBM 704, 705, 7070, 709, 7090, etc.
9. Space and power needs.
10. Ease of programming.
11. Autocode systems available for machine.
12. Library and subroutine facilities for machine.
13. Training schemes for computer staff and management.

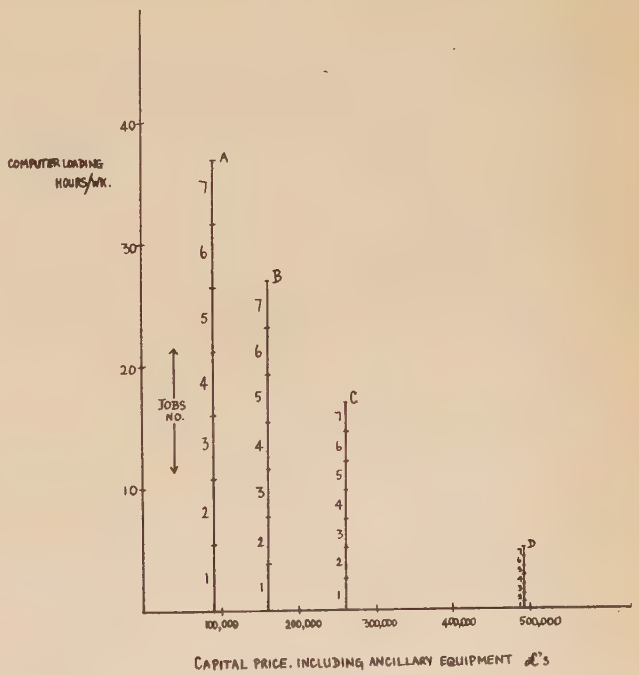


Fig. 4. *Estimated weekly loadings for* 4 *computers against cost.*

14. Availability of a computer for programme testing, before delivery of own machine.
15. After sales service.
16. Background of manufacturer's experience in work of similar kind.
17. System study help offered by manufacturers.
18. Numbers of staff required to operate whole system—operators, programmers, engineers, system analysts.

Specifications

The manufacturers should give answers to all these points. This supposes, of course, that the job specification has been sent to a manufacturer. But how do you choose your manufacturer? There are over ten firms marketing computers in England. It is a waste of time and effort for all if a specification is sent to each one. A selection must be made. Some criteria for selection of firms are:

(1) By direct experience of their equipment.
(2) By published work on similar jobs to yours.
(3) By reputation or recommendation.

A computer consultant can advise on selection of manufacturers just as he can on the selection of the hardware.

It will help you and the manufacturers if you bring them into the picture before the job specification is sent to them. They will then know the background to the problem and, with the possibility of a contract, will offer good advice in preparing jobs for a computer. By keeping the manufacturers in the picture much time is saved. The specification, however good it is, will have some ambiguities. A manufacturer who receives a specification "out of the blue" cannot do full justice to his replies. He will want to send his representative to discuss it with you. This takes valuable time which could have been saved by giving him some warning.

There comes a time when you—as a potential computer customer—have all the information you can get and you must choose your machine. You have the price (watch the rental for second and third shifts), delivery, maintenance costs (again watch cost of extra shifts), running costs, machine and auxiliary equipment loading. You have weighed up the intangibles—service facilities, programming help, background and so on. Finally you add up the free lunches, beer and night-clubs, weigh the manufacturers' replies on the kitchen scales (a good one should be about 2 lb. 12 oz.), see if you can use their bindings for your own files and decide! One, two, or even more years' work has ended—but the real work has yet to start!

Paris–Orly Airport to Install Computer Control

As a first step towards automatic control of air traffic, an experimental flight-plan processing system, based on an IBM 650 Ramac, was installed at Orly in September 1961. The system is designed to work side by side with the existing control methods to provide valuable experience in the new techniques of air collision prevention already widely used in North America.

The system will automatically produce flight strips, giving estimated time of arrival over certain fixed points along the route. This information is also stored in the computer's memory and is used to predict possible dangerous situations or conflicts. As the flight progresses these estimated arrival times for the rest of the flight are recalculated using the latest navigational reports received from the aircraft via radio telephone.

Data on the characteristics of aircraft and details of air routes are also held in memory. This ensures that the input is as simple as possible. For regular scheduled flights the route is merely indicated by the departure and arrival points. Aircraft flying non-regular routes are also catered for but geographical co-ordinates of its route are necessary.

All conflicts are indicated to the controller in whose sector the situation occurs, this will be in the form of a printed message. The computer will also check that the avoiding action, suggested by the controller, is acceptable and does not cause further conflicts.

The new system will be operating before the end of 1961 and, at a later date, co-operation with the military defence system is envisaged.

New Punched-Tape Splicer

Dresser Products Incorporated, manufacturers of the *Tape-File* line of data-processing accessories, announces a new punched-tape splicer and a supply of splicing tape that make it possible to splice five to eight channel punched tape, at any place, in seconds, without electrical connections.

The splicer is a precision instrument with built-in squaring shears for butt splices. It locks firmly and easily. This guarantees adhesion and minimum build-up. The splicer has a 4 × 9 in. base, weighs 4 lb.

The *Tape-File* splicing tape is pre-gummed and fully punched. It is available in $\frac{11}{16}$in., $\frac{7}{8}$ in. and 1 in. widths—10 ft, 25 ft and 100 ft lengths. This new splicing tape makes it possible to splice at end of message code, to form loops, or splice a torn tape within a message without character losses. It works equally well with oiled or non-oiled tape. There is no bulky build-up. The increased thickness of the spliced tape is less than 5 mils using paper splicing material, and less than 2 mils using special materials.

For additional information about the *Tape-File* line, write to Dresser Products Incorporated, P.O. Box 2035, Providence 5, R.I., USA.

*   *   *

BUSINESS LANGUAGES AND ELECTRONIC COMPUTERS

*by R. M. Paine**

A talk given to a non-specialist audience at the British Association for the Advancement of Science at Norwich on 5 September 1961.

Introduction

The use of electronic digital computers for business applications is spreading in many countries, especially in the USA and Britain. At least 14 different manufacturers offer computers for commercial work in the UK and there are about 600 large scale and 5,000 medium scale computers in Europe, USA and UK. Many hundreds of line executives, organisation and methods personnel, systems analysts, and programmers are trying to communicate with each other and with the machines in order to get these machines to carry out exactly what the management of the firm requires.

The people involved find it difficult to tell each other the exact requirements let alone inform the machine, and this is partly due to the lack of a common language in business procedures such as there is a mathematical notation for scientific work. Thus, though I am mainly concerned with a standard commercial language to tell the computer what to do, it should be remembered that agreement on such a language is be-devilled by the failure to have accepted symbols or expressions in business.

"Talking" to Computers

When we instruct a computer to do work it is analogous to instructing other human beings, but we have to consider the different organisation of the human mind and the computer "mind." The heavy cost of communicating with machines by people writing in machine language—such as numeric codes and a fixed instruction format as shown in the example—has led to a study of how machines can accept human languages such as English—and indeed to a re-examination of "the meaning and structures of language."

		60	6	31
25		72	5	34
	4	00	4	17
26		74	13	33
		74	17	32
27		37	13	32
		74	9	33
28		42	7	19

Example of Machine Code

Many ways could be used to "talk" to computers such as Chinese picture symbols. Incidentally the Chinese symbol for "riot" is formed of two identical symbols for "woman," with a broken line across to indicate a roof. Thus two women under one roof indicates a riot. The English language or transatlantic versions of it have, however, proved popular in the USA and the UK as a means of instructing computers, and easing the burden and cost of systems analysts and programmers. The structures of these automatic coding languages is very similar and reads like a stilted form of English. It is rather as if computers were being colonised and taught pidgin-English as happened in the nineteenth century in various countries of the world, with the natural reluctance of the British to learn a foreign language. The developments in programming—as contrasted to the actual physical parts of the machines which are known as "hardware"—are called developments in "software"—which should not be mistaken for a new brand name for toilet manufacturers.

Existing Automatic Coding Languages

An example of one of these autocodes will help and can be contrasted to the previous example of machine coding:

```
OVERTIME. IF MONTH-NUMBER IS NOT EQUAL TO 3, GO TO
   PRINT. IF OVERTIME-RATE IS EQUAL TO 0, MULTIPLY
   SALARY BY 0·015 GIVING OVERTIME. OTHERWISE MULTI-
   PLY SALARY BY OVERTIME-RATE GIVING OVERTIME.
   GO TO PRINT.
```

Remington Rand's "Flowmatic," *Honeywell's* "Fact," *Ferranti's* "Nebula," *IBM's* "Commercial Translator," are all very interesting languages of more or less the same quality. They had one drawback in that they were not standard and if a user moved from one computer to another as sometimes happened, he would have to learn a new autocoding language before communicating with the machine. It would not be as difficult as learning a new machine code but it would be inconvenient. Just as before the standardisation of screw threads it would be most inconvenient if in building a shed one made purchases from two shops and then found the nuts would not fit the bolts. Or as inconvenient as a different gauge of railways in different states causing a change of train.

COBOL—A Common Language

Many manufacturers and users therefore got together in a very long study which finally produced the language COBOL—Common Business Oriented Language. It is to some extent a compromise, and it may lack some of the virtues of any one of the independent languages, but at least it is a beginning on a universal language for business, and it is perfectly adequate for writing most business procedures. At the moment about 10 computer manufacturers representing about 80–90% of the world's output of computers have adopted COBOL and are writing compilers for it and many business users are employing it. Work is going on to improve the language and it should not become an out-of-date rigid structure such as the Albert Memorial.

* *C-E-I-R (U.K.) Ltd.*

An examination of sentences in Cobol or Comtran or Nebula such as

PERFORM TABLES VARYING MODEL FROM BASIC BY 1 UNTIL MODEL = TOTAL

and

SET RATE = (BASIC + OPTION) *PRICE/VOLUME

shows that in the main there are:

1. Verbs—telling the computer what to do—such as "Perform," "Multiply," "Read," "Move," "If," "Set."
2. Nouns or names—telling the computer on what things to act, such as "Model," "Month-number," "Overtime-rate," "Basic." These have previously been defined to the computer on another form.
3. Paragraph names which group the statements—such as "Tables," "Print," "Overtime."
4. The rest are mainly noise words which do not really help the computer but make the statements more readable to human beings. But such matters as word-order, punctuation marks and spacing are significant to the master programme which actually translates from the "English" language to the machine code.

There are in most autocoding languages a limited number of verbs or computer functions, but no limit on the nouns or names of variables.

Computers have no Nationality

People whose own language is not English wish to use automatic-coding, and at the moment people in Sweden and Holland for example seem content to learn the English necessary to write such systems as COBOL. Now computers have no inborn nationality as far as I know, and it should be possible for users to speak to the machines in their own tongues—a computer can be taught Russian as easily as English.

A development by *ICT* in the United Kingdom of COBOL known as Rapidwrite shows great possibilities in this respect, and in the elimination of errors due to non-compliance with the required format of COBOL statements. Only a limited number of possible COBOL statements are allowed and these are pre-printed on punched cards, omitting many of the noise words. There are about eleven different types of procedure cards, one for each verb allowed in the system. On the face of the card can be filled in the data-names or nouns used in the statement—there is no need to fill in the correct sentence structure. The card can then be punched and used as input to the computer for compiling into machine-code. Now a German could use his own verbs, e.g. for "Compute," and have the cards specially printed so they could be understood in German, and use German data-names or nouns—the position of the verb in the sentence might even be in a different position to allow for national differences. But as long as the card is punched with a code to show that it is a "Compute" card, the machine can understand it and translate it into machine code. Thus an international business language could work without undue reliance on English.

Future Possibilities

Even when man has achieved some international agreement and advanced to a standard language for computer business applications, he is not satisfied and is already looking ahead for the next step.

At present languages such as COBOL describe in some detail the steps in the process to be carried out—such as invoicing or sales statistics. Programming effort is reduced but it would be reduced still further if a language and system could be introduced which only required the user to state his problem and not the solution of it. This would make better use of a computer by giving the machine the input information to be used and the results required and allowing the computer to work out how to get from one to the other.

Too much time is still required, many man-years, to write the master programme which allows each manufacturer's computer to translate from the English language to the machine code in which all applications are eventually run on the computers. It is not too much to hope that in the future this time-consuming job may be reduced. One approach is a general purpose translation technique such as is being developed at Manchester University for the Ferranti ATLAS computer. This accepts the specification of any programming language and the specifications of any computer, and will then compile a programme written in that language to run on the given computer.

A second approach is to allow the computers to have built-in functions which can understand some of the expressions used in autocoding languages and the new Burroughs 5,000 computer has such facilities—for this should make the master programmes easier to write.

The acceptance of a standard business language may gain even wider support in the world since the subject has now been taken under the wing of the "International Organization for Standardization."

In May 1961 a conference was held in Geneva on standards in Computers and Data Processing, and how universal was the interest is shown from the fact that Belgium, Czechoslovakia, France, Germany, Italy, The Netherlands, Poland, Sweden, the UK and the USA were participating members, and observers were present from Australia, Burma, Canada, Chile, Denmark, Greece, Hungary, Ireland, Israel, Japan, New Zealand, Rumania, Spain, USSR and Yugoslavia. Let us hope that the situation, as exists in the middleweight boxing division, of two world champions, does not arise in the computer field.

Conclusion

"Esperanto" has never caught on as much as its inventors hoped, a common business language should have greater success but it should not be overlooked that it will be difficult to have complete acceptance. Automatic-coding languages should certainly spread the use of computers for commercial work both from more firms owning computers and more firms making use of service facilities such as my own company offer. Perhaps in the far future computers will even have to know the language of other universes to aid man in his journeys through space, and his communication with other worlds.

MACHINE TRANSLATION CONFERENCE

Reported by R. M. Needham

The first International Conference of Machine Translation of Languages and Applied Language Analysis was held at the National Physical Laboratory from 5–8 September. Papers were presented from a large number of countries, and the Proceedings will give an excellent overall view of the state of this research.

Many fewer people now say that MT is on the edge of solution than was the case a few years ago. There is a progression (which is sometimes denied by those who make it) from hopes of almost immediately usable results to a realisation that before MT can be done properly an immense amount has got to be found out about language and languages. As far as machinable operations are concerned, the the facts are just not there in the dictionaries and grammar books, which were made for use by human beings with a good deal of background knowledge. There is controversy in the field as to whether the missing facts are best to be found by more thorough dictionary making based, essentially upon people writing down what they know of how words are used, in some suitable standardised manner, or whether, alternatively, the solution will be found through the use of machines to examine, by scanning vast corpora of text, how the words are in fact used. The objection to the former course is based on possible non-objectivity, to the latter in doubtful practicability on a sufficiently large scale. The former approach was exemplified in the papers of M. Masterman, and of S. Ceccato and his collaborators; the latter is more popular in the USA, and was represented by the papers of M. Zarechnak, S. Chatman, K. Harper and S. Lamb.

Discussion of syntactic analysis continues, though perhaps with less asperity than before. At previous conferences there has been a good deal of controversy about the relative merits of repeated scan techniques and of single-pass predictive techniques, whether from left to right or from right to left. Within the former variety, there were vigorous proponents both of analysis of sentences by splitting into major constituents, and alternatively of analysis by building up the sentence from its detailed components. Now it seems to be recognised that all these methods can work, that different ones may be appropriate for different languages, and, most importantly, that the real problems facing syntactic analysis come up equally in all the methods. New kinds of syntactic description, which may effect great simplifications, were described by A. F. Parker-Rhodes and I. Sakai.

During the Conference, but independently of it, a demonstration of an MT system was given by Machine Translation Inc., of Washington, DC. Using an IBM 7090 they are currently able to process some 60,000 words per hour, using a dictionary of 5,000 Russian entries. It is not very clear exactly what is shown by such a demonstration as this; for several years people have been in a position to produce fairly convincing MT on a small scale, but one cannot argue, as painful experience has shown, from success on the small scale to success on the large. Machine Translation Inc. claim to have solved the basic problems, and profess themselves baffled as to why other workers in the field are still struggling on. How justified they are in this will appear in a year's time, when, by their current expectations, they will be able to produce usable MT at 150,000 words per hour on general technical material.

REGIONAL BRANCH NEWS

EDINBURGH

A Branch of the Society has been formed recently at Edinburgh and members interested in affiliating to this Branch are requested to communicate with the Branch Honorary Secretary, J. S. Armstrong, Heriot-Watt College, Chambers Street, Edinburgh.

The inaugural meeting was held on 13 December. Further meetings on Transmission of Data and Autocoding for Business are arranged for 23 January and 20 March respectively. It is hoped to organise a visit to Bruce Peebles on 21 February.

GLASGOW

The Glasgow Branch of The British Computer Society held its first meeting of the 1961–62 session in the Royal College of Science and Technology, Glasgow, on 16 October. The speaker, Dr. D. C. Gilles, Director of the Computing Laboratory in the University of Glasgow, took as his title, "How to Assess a Computer," and the thirty branch members present enjoyed a stimulating talk which was not without its moments of humour.

Since coming to Glasgow, Dr. Gilles has on two occasions had to make a choice of a Computer, and the Branch was thus fortunate in having a speaker who has had some experience in assessing the capabilities of computers.

Dr. Gilles listed ten points which have to be considered. Perhaps the most important single factor is *performance*. This involves speed of computation, capacity, and, particularly for commercial installations, input/output arrangements. It is difficult to find a single quantity to measure performance, but, at least for scientific computers, the speed of matrix multiplication forms a useful yardstick. Closely followed by performance, and obviously related to it, is *price* and, in fact, the problem of selecting a computer eventually reduces to the question of how might a given sum of money best be spent.

The question of *reliability* was, in the opinion of Dr. Gilles,

less important for a University installation than for a commercial system. The increased reliability of transistorised machines raises the interesting possibility that when faults do occur, the engineers, through lack of practice, may take longer to correct them.

The question of what *maintenance service* is necessary must be considered. In particular, if maintenance is by the manufacturer on an "On-call" basis, how long will it take to get an engineer to the site?

Dr. Gilles thought it desirable to choose a system which is capable of *extension*. It is a mistake to instal a system which cannot be enlarged at a later date, for problems, especially in the scientific field, tend to become larger.

The programming system used should be studied carefully, particularly to ensure that facilities for instruction modification are adequate. Built-in floating point working is desirable for any large scientific computer.

The *extent of the program library* should also be examined, and, if the machine is a fairly new one, an idea of the rate of growth of the library can be obtained from the number of machines of this type already in use or on order.

Any *special requirements of the installation* must be taken into account. The system may need to be compatible with other branches of the organisation, or, work of a special kind may have to be done. The next point which must be considered is *the record of the company* which makes the machine. What are their previous machines like? Is this the first computer which they have designed? Do they use it themselves? (If not, why not?) Are their delivery dates and estimates of cost reliable?

Once all the above points have been considered, there remains one's *own impression*. The impression which a prospective buyer has of any machine is coloured by personal preferences and personal experience. It is as well to recognise that this may be an important factor in determining the final choice.

Numerous interesting points were raised in questions after the main talk, and all questions were ably dealt with by the speaker.

LEEDS

The Branch, having been somewhat dormant for the last session or two, started this season's activities with a meeting on 27 September, attended by over forty members and guests, when Dr. M. V. Wilkes of the University Mathematical Laboratory, Cambridge, gave a talk entitled "A second look at Data Transmission." This was the follow-up on a talk by Dr. Wilkes in an earlier session.

Dr. Wilkes described some of the developments now taking place in data transmission, including the types of transmission channels available and the different methods in use for the control of errors, illustrating his talk with slides.

The second meeting was held on 25 October, when Mr. D. A. Bennett of *Ferranti Ltd.* described some of the problems confronting manufacturers of commercial computers, in particular those connected with the design and manufacture of computers and the difficulty in obtaining appropriate staff.

After each talk, question time produced quite lively discussions on the topics under consideration.

LEICESTER

There have been two very successful meetings this session, with attendances well above the average.

The Branch was fortunate in having two key figures from the NPL Symposium on Modern Computing Methods along to an afternoon meeting on 14 September.

The meeting was opened by Dr. E. T. Goodwin, Superintendent, Mathematics Division, NPL, who pointed out that one of the main concerns of the NPL book (*Modern Computing Methods*, NPL Notes on Applied Science, No. 16, 1961) was to discuss the suitability of various processes in numerical analysis. Apart from the different requirements of hand computation and automatic computation, the merits of a process often varied with particular computers. Hence the importance of machine users Colloquia which should be encouraged by all manufacturers of machines.

Mr. J. H. Wilkinson then spoke on linear algebra, eigenvalue analysis, polynomial factorisation and partial differential equations. Dr. Goodwin spoke on finite difference methods, Chebyshev polynomials and ordinary differential equations. Leicester was thus fortunate in having a less formal and very instructive repeat of the important NPL Symposium on 14 June (*Computer Bulletin*, September 1961).

In answer to a question on subjects which were omitted from the present publication and which the authors would consider including in a subsequent edition, the following were mentioned: Integral equations, curve fitting, Monte Carlo methods and linear programming. On the last subject the speakers said that the NPL had been tardy in taking up a study of linear programming, because the earlier problems presented to them were quite unrealistic and that only now was suitable material appearing.

Finally, Dr. Goodwin gave an encouraging statement on the future of mathematical tables. Very comprehensive tables of functions could be published in condensed form by giving coefficients of Chebyshev polynomials valid to a given accuracy over part of the range together with asymptotic or alternative expressions for the remainder.

On 26 October, we were very pleased to welcome Professor M. W. Humphrey Davies of Queen Mary College, University of London, who gave an illustrated lecture on "The Use of Computers in the Design of Heavy Engineering Equipment."

Without going into details of any particular design problem, Professor Humphrey Davies gave a very stimulating survey of the subject commencing with a typical design flow diagram and ending with suggestions on how best an engineering firm could organise its computing facilities and personnel.

Although the mathematics in a design calculation is generally quite straightforward there is great difficulty in deciding the logical rules for the optimisation of the design. This difficulty is increased because from the viewpoints of engineers, plant managers, economists, etc., the criteria for optimisation are quite different.

Although many people had been quite successful in using computers for the physical design of the equipment and to a lesser extent for tendering, the greatest progress that could be made was in the control of the manufacturing processes. Professor Humphrey Davies envisaged a time when the Drawing Office could be by-passed completely with, perhaps, paper or magnetic tape or card control of machine tools. Digital plotting machines could be used to do drawings for the customer or factory if necessary.

On the organisation of computing facilities Professor Humphrey Davies suggested that there should be a central advisory service, doing fundamental work of a specialised nature, e.g. numerical analysis. It should not do the design offices' work, but, to assist the designers, programming assistants could be detailed out to the various sections of the

firm as required. Computers could take the "donkey work" out of design, and design offices could then attract more and better people.

LIVERPOOL

On 10 October the Annual General Meeting was followed by an address given by our President, Professor L. Rosenhead, who took as his title "Charles Babbage." The speaker concentrated on the personality of his brilliant but irascible subject and brought to light many activities (particularly regarding the formation of learned societies) which were previously unknown to his audience. The Branch Secretary is now Mr. J. M. Watt, The Computer Laboratory, The University, Liverpool 3.

MIDDLESBROUGH

The 1961–62 programme began on 26 September with a symposium on Computers and Computing on Tees-side. Over 50 people attended and they listened to speakers from six local firms describing what use their firms made of existing computers or the proposed use of computers on order.

On 24 October another well attended meeting was addressed by Mr. A. J. Barnard, Norwich City Treasurer, on "Progress on the Norwich Computer."

SOUTHAMPTON

The year has started off quite well, and two meetings have been held so far.

The first was an interesting description of the way in which the census results are being processed on the IBM 705 at Worthy Down. Approximately 35 members were present. The second meeting was held early in November, in which Mr. Hindle of Martins Bank described some of the methods which are being used by the banks to aid them in their large-scale operations. In particular he discussed character recognition and some of the problems which it causes.

BOOK REVIEWS

The Mechanics of Inertial Position and Heading Indication

By W. Markey and J. Hovorka, 1961; 94 pages. (London: *Methuen and Co. Ltd.*, 21s. 0d.)

The authors of this book would appear to have seriously overestimated the abilities of the graduate student, for whom it is said to have been written. In the interests of absolute accuracy, style and clarity have been sacrificed to such an extent that it becomes extremely laborious to follow discussions of what are, in many instances, basically quite simple phenomena. There is also a tendency for the authors to assume that the reader is familiar with terms in common use by specialists in the field; for instance, the few sentences of description covering the "single-degree-of-freedom integrating gyro" are completely inadequate for anyone who does not already know what is meant.

From the computing engineer's point of view, the book does indicate the magnitude of the tasks which the computing units of an inertial navigator have to perform. But it does not give any information showing how these problems are instrumented in current designs, or the accuracies necessary in the various computing operations.

For the specialist in inertial navigation, the book contains a large amount of information in compact form, and should prove a useful addition to his library.

I. L. THOMAS

Electronics: A Bibliographical Guide

By C. K. Moore and K. J. Spencer, 1961; 411 pages. (London: *Macdonald and Co. Ltd.*, 65s. 0d.)

The fact that electronic computers are allocated one section out of sixty-eight in this book, and provide only about two per cent of the references, shows clearly that they still rank as one of man's more ordinary achievements so far as the electronic engineer is concerned. This may well be so; the book probably gives a fair comparison of the amount of work done in various branches of electronics. It prompts the reflection, however, that one must be wary of confusing the rank of computers as a subject for the electronic engineer with their importance as a tool for mankind.

This book is designed as an aid for the intelligent user of technical libraries. It lists a judicious selection of books and articles, grouped by subjects, chosen because they provide useful references or are outstanding contributions to electronics. Computers, for example, are covered by about 70 references ending at June 1959. The choice, particularly in the later years, seems a little haphazard but this is probably unavoidable. One notable paper on CRT stores has unfortunately found its way into the section on television camera tubes. These, and the somewhat crude numbering system, are, however, minor blemishes in a book that will be of great value to technical librarians and to that new phenomenon, the "information officer." Its comprehensiveness can be gauged from section 1.01 which contains a list of bibliographies of bibliographies.

S. GILL

Analog and Digital Computer Technology

By N. R. Scott, 1960; 522 pages. (New York: *McGraw Hill*, 99s. 0d.)

The text of this book, which covers the principles of analogue and digital computers and electronic differential analysers, has been well prepared, and the explanations are given in an informative manner. The author, Dr. Scott, at present teaching at the University of Michigan, is also an engineering consultant in the United States on computer problems.

The book is intended for graduate engineers, but with its comprehensive coverage it could well serve as a reference book in a technical library; of particular interest are the references in the bibliography, which gives a very wide coverage on computer technology.

This work should be of particular interest to electronic engineers already familiar with the broad principles of computer engineering, since it deals very concisely and completely with such aspects as solving problems on digital computers, mathematical logic and switching networks, and logic circuits and control. The information provided is not normally included as thoroughly in textbooks on computer design.

In the final chapters references are made to techniques now being developed, particularly concerning new methods of storage, but the author does not claim to provide complete information on this aspect.

This book will be a valuable addition to the technical libraries of companies engaged in computer development, and simulator and data handling equipment design.

D. McNaught

Electronic Computers and Their Use by Local and Public Authorities

By Alban and Lamb, 1961; 16 pages. (London: *Charles Knight and Company Ltd.*, 1s. 0d.)

This booklet is a reprint of a series of articles first published in the *Local Government Chronicle* and is directed primarily to "treasurers and finance committees who may be contemplating installing an electronic computer." It was written for the layman and provides up-to-date information on data processing developments in the local authority field.

By reducing the technical jargon to a minimum, the writers have produced a useful primer for the non-expert. Brief descriptions of a number of the machines currently available are given, though these appear in various sections of the booklet instead of being brought together under one heading.

More space could have been devoted to systems investigations, re-training of staff and the costs of running an installation, as it is these which are of most interest to senior officials considering the introduction of punched card calculators and computers. Also, it should be remembered that, particularly to the layman, a general statement is often confusing rather than informative. Thus to say that programs "take a long time to prepare" gives virtually no information and could lead to quite a wrong conclusion being drawn.

However, these are only minor weaknesses in what is otherwise a very readable little publication.

A. W. Haysman

Digital Data: Their Derivation and Reduction for Analysis and Process Control

By D. S. Evans, 1961; 82 pages. (London: *Hilger and Watts Ltd.*, 15s. 0d.)

This book is useful as a description of some commercially available shaft digitisers and devices for reading and decoding them and displaying or printing the results. Its limitation in this respect is that it concentrates too much on the products of a particular manufacturer.

A much more serious criticism must, however, be levelled at those parts of the book which attempt to deal with the more fundamental aspects of systems. These parts of the book are not clearly or logically described and contain errors in both theory and detail. This can be illustrated by considering Chapter 2—Digital Counting Devices.

The author considers a moving disc grating with, say, clear lines on an opaque background and a similar fixed viewing grating. This is used with a simple lamp, photocell system to count the passage of lines past a fixed point. The author confuses this by using as his unit of displacement the width of the opaque lines where it would be more logical to use the pitch of the lines. This is particularly true in a Moiré grating where the width of the "lines" has no meaning. The author then discusses the vernier-type grating in which the pitches of the fixed and moving gratings are different. Errors in his Fig. 4, where the viewing area is shown as one fixed slit, and in Fig. 5, where one cycle of light output is shown for a scale movement of 20 lines (instead of 2), have led the author to claim some advantages for this simple system. A more sophisticated system would, in fact, be needed to gain any advantage from a vernier system. In the Moiré grating case his diagram shows the viewing area to include a complete fringe—if this were so the total light output would be constant.

Chapter 3, the longest chapter, shows some digital coded scales suitable for measuring shaft position, and circuits for decoding them to pure binary. There are then photographs and descriptions of several types of single and multi-turn shaft digitisers. To many readers, this will be the most useful part of the book. Chapter 4 describes ancillary equipment such as amplifiers, digital stores and diode matrix encoders to provide different codes and parity digits for output punches or typewriters. Chapter 5 shows various ways of connecting up shaft digitisers and their ancillary equipment. There are 11 similar diagrams showing slight variations, where 4 or 5 would have been better.

D. V. Blake

An Introduction to Computer Methods

By K. A. Redish, 1961; 211 pages. (London: *The English Universities Press Ltd.*, 30s. 0d.)

In the preface the author says: "This book is written for the 'occasional' computer and for students of science and engineering who increasingly need a knowledge of numerical methods. . . ." As such it can be recommended if we agree that the "occasional" computer does not use a high-speed automatic machine.

The first six chapters deal very adequately with simultaneous linear equations, non-linear equations and finite differences. They are followed by two chapters on ordinary differential equations, and one on functions of two variables

which include a brief discussion of partial differential equations. The last chapter describes a number of problems and techniques which are not easily classified under the earlier headings. An appendix gives a selection of commonly-used formulae.

One shortcoming that many will regret is that apart from a list of eleven standard books, references are almost non-existent so that the reader who wishes to pursue any topic further is scarcely catered for. Incidentally, the reviewer searched in vain for the meaning of "MCM" which is referred to on p. 176; the initiate will interpret this as Modern Computing Methods (*NPL Notes on Applied Science*, No. 16, second edition 1961, HMSO).

The bias toward desk-machine methods, though deliberate, gives cause for regret in places. The section on polynomial equations, with its lengthy discussion of the root-squaring process might well be regarded as out of date. Also the numerical analyst will notice the omission of those two powerful and widely-used tools due to Aitken, his interpolation formula, and his device for accelerating the convergence of a sequence with a finite limit.

The book is very reasonably priced at thirty shillings and the layout and printing are admirable; the reviewer found only a misplaced suffix on p. 155 (Question 5) and a missing symbol on p. 96; throughout the sign of "error" (e.g. p. 2) seems unconventional.

The book may seem to invite comparison with Modern Computing Methods, each being a comparatively brief survey of a very wide subject. It should at once be stressed that while one is for the occasional desk-machine user, the other is for the serious computer, and this distribution should enable the newcomer to the subject to make his choice. Since both offer good value, it is to be hoped that both will appear on his shelf.

A. R. CURTIS

Principles of Regression Analysis

By R. L. Plackett, 1960; 173 pages. (Oxford: *Clarendon Press*, 35s. 0d.)

The author states in his preface: "The field of regression analysis is here supposed to consist of the algebraic theory and numerical methods associated with the principle of least squares, its application to the analysis of experimental data, and the construction of experimental designs."

There is, in fact, considerable emphasis on numerical methods, with worked examples, with layout for desk calculators given in each case "since most regression computations can be done on such machines in reasonable time." Though this reason can hardly be regarded as valid, it is nevertheless useful to have the methods paraded in this way—leaving adaptation to automatic computers for those interested in doing so.

The array of methods is wide in scope and substantial in number, culminating in many recent methods of high sophistication. For familiar and elementary processes such as solution of normal equations, and inversion of matrices, the general balance of the book has meant that the choice of methods demonstrated is restricted, and familiar methods will be missed; nevertheless a reasonable method is always given. Even in this chapter the reviewer found fresh ideas.

The reader needs a considerable familiarity with statistical definitions and methods, but, having this familiarity, he will find the exposition of the numerical methods very useful. There are substantial sets of exercises to encourage the reader to work for himself. The book is, of course, beautifully printed.

Chapter Headings

1. Linear Equations.
2. Quadratic Forms in Normal Variables.
3. Least Squares.
4. Linear Hypotheses.
5. Departures from Standard Test Conditions.
6. Polynomial Regression.
7. Stationary Error Processes.
8. Symmetrical Factorial Experiments.
9. Randomisation.

J. C. P. MILLER

Automatic Data Processing Systems

By R. H. Gregory and R. L. Van Horn, 1960; 705 pages. (San Francisco: *Wadsworth Publishing Co.*; London: *Chatto and Windus Ltd.*, 55s. 0d.)

This is a large book of over 700 pages filled with useful information for people interested in various aspects of computer systems, but especially in their commercial applications.

The authors build up their description of computers from very simple beginnings, and give detailed explanations, with many examples, of such things as non-electronic business machines, flow charts, programming and computer arithmetic. Though it does not detract from the information given, the examples of equipment and the history of computers seem to be entirely American. One of the few mentions of Britain is of the Loch Ness Monster—information which Bob Gregory probably acquired on his visits to the Dundee Technical College summer school, where he became well known to many BCS members, including myself.

The later chapters in this book show the business man many of the purposes and requirements of systems analysis, including a feasibility study and equipment selection. Thus the book would be useful to many managers who might wish to skip some of the earlier chapters on coding, etc. In fact this is one of the features of the book—that it can be entered at several points by readers with different interests. As may be seen from this review so far, the subject-matter is not different from other books on this topic. But the authors deal with it in such a thorough and expert manner that this volume is placed well above others in its class—like the difference between a newspaper "profile" and a complete biography.

The scheme of the book in placing questions after every chapter should do much to drive home the points made—in fact I found some of the questions most searching, and was driven back to re-read the chapter before attempting an answer. For instance we are given a description of a particular printer and are then asked to "determine the layout of data for fastest printing of checks and stubs." Could you answer the question, "How different are the data requirements of vertically and horizontally integrated organisations?"—if you do not even understand the question you must surely read Gregory and Van Horn. In the questions to the last chapter we are given a description of a bank's requirements and a hypothetical data processing system, the PQ–10, and we are asked: "Can the PQ–10 handle the load?"

This as you can see is definitely not a book to rush through.

One of Bob Gregory's firm convictions in his lectures in Britain—the insistence on the distinction between "data" and "information"—is present throughout these pages. Many may not agree with the need to use these terms so rigidly—but here "data" are the raw material from which management distills "information." This concept is important to those that believe that the real purpose of computers is not merely to print as many pages of unheeded reports as possible in each succeeding second.

There are some criticisms to make of this book—especially the predilection either (*a*) to express the simplest relationship in charts which only tend to make them seem complicated, (*b*) to use graphs to give a more precise connection between the intangibles concerned than seems warranted by the facts available. These traits are especially prevalent in the chapters on "Data and Information: Cost and Value" and "Systems Economics." Many American books seem to rely on these irritating graphic methods when they are not really necessary—even literary evaluations of famous authors such as Shakespeare. There are one or two minor points—I would like to see more on variable length working, and the flow chart on p. 91 seems incorrect.

But I can recommend this book as well worth reading and studying—a good companion in the book-case to *Programming Business Computers* by McCracken, Weiss and Lee.

R. M. Paine

Memory, Learning and Language

Edited by W. Feindel, 1961; 69 pages. (London: *Oxford University Press*, 16s. 0d.)

This little book is addressed to the intelligent layman and it gives a very readable introduction to a number of sciences which are converging on the study of the brain. Presented originally as a verbal symposium, these papers have now been edited and brought together. It is hoped that the publication of this small volume, made possible by a grant provided by the Board of Governors, will help to commemorate the first half-century in the history of the University of Saskatchewan. Although each of those taking part discusses the physical basis of mind from a specialised point of view, it was intended that the symposium would also be informative and perhaps provocative for a general audience concerned with the broad problems in the field of education.

After a philosophical and historical introduction, there are chapters on neurophysiology, neuropharmacology, control engineering and human speech. It is salutory to read from Dean Leddy that the Greeks in two explosive centuries pinpointed many of the key problems of memory and from Wilder Penfield that Socrates might ask some questions which, even today, would make us blush.

Professor Feindel describes some of the key facts of the neurophysiology of the brain and some of the few fish which have been trawled from the EEG ocean. I would query one of his statements regarding memory. "The two main regions of the brain concerned with memory lie just inside the temple in the portion of the brain called the temporal lobe." Would it not be more true to say that only in this area has memory yet been demonstrated? Penfield emphasises our lack of knowledge on p. 65. Professor Hoffer gives a fascinating summary of how thought can be modified by chemical means; the union of psychology and chemistry may, one day, empty our hospitals of schizophrenics.

The President of Saskatchewan University, Dr. Spinks, describes a "guided missile" whose target is a radioactively tagged wireworm burrowing at a few inches per hour in the soil. Designed for a soil research project the tracking "Crab" has some of the features of an automatic curve follower. Dean Arthur Porter contributes a long paper on the mechanisation of thought processes which covers the field very well. I would not divide learning from thinking so sharply as he does, nor suggest that we can mechanise the former but not the latter; and is speech an essential for thinking?

The neurophysiology of speech is the subject of the last chapter by Wilder Penfield, and this is so elegant and enlightening that any summary would be impossible.

A. M. Uttley

An Introduction to Electronic Data Processing for Business

By L. W. Hein, 1961; 320 pages. (London: *D. Van Nostrand Co.*, 56s. 0d.)

In his preface Professor Hein points out that his book is to be regarded as a textbook on EDP. It has been written as a college textbook but is also intended for senior/graduate courses in schools or departments of business. So far so good, but does this book fit into the English scene in 1961?

The book is divided into fourteen chapters—the first five on simple computers and programming, one on flow charting, two on a simplified data processing problem, the next five on file maintenance, sorting, merging and report writing. The last chapter (25 pages) is on Advanced Programming Concepts.

If the book is a textbook for future computer programmers then the choice of a real computer (and an obsolete one at that) is wrong, for the author is forced into detail of the particular machine. The chapter on advanced programming should surely have been expanded. The book is dated September 1960, and a better example than SOAP could have been chosen to illustrate advanced programming.

Another way to view the book is for potential managers. Here the mass of detail on programming, sorting, merging, etc., far outweighs the one chapter on how to set out a problem—flow charting. Managers are usually content to leave the details to their staff. They must, however, know enough to appreciate what computers can and cannot do. Few managers could sort that out from this book.

In conclusion, for the English market, this book falls between two aims—a programmer's textbook and a management appreciation. No experienced programmer will question Professor Hein's accuracy and style—but where is the experienced programmer who has time to read this book!

P. G. Barnes

CORRESPONDENCE

Letters from readers are welcomed, and should be addressed to the Editor, The Computer Bulletin, Finsbury Court, Finsbury Pavement, London, E.C.2. The name and address of the writer must be given, but will not be published if requested.

Priorities in Time-Sharing

Sir,

The advent of time-sharing will bring with it the problem of assigning priorities to users of a large central computer. It may safely be assumed that the next generation of computers will have instruction speeds of the order of one microsecond, and facilities for interchanging within twenty milliseconds a program in the main memory and a program in the backing store. Thus, it would be feasible for the computer to perform forty short, five-millisecond runs within any one second.

The scheduling of runs will be performed by a supervisory program which will also record accounting information. The problem of scheduling a queue of runs according to some priority system has not yet been solved, but it may be assumed that some satisfactory form of scheduling will be developed during the next five years.

However, any scheduling scheme presupposes some method of assigning priorities. The following scheme for the assignment of priorities is suggested.

Assume that each user of the time-shared machine is equipped with an input-output console, which includes a dial on which the user can indicate the price he is willing to pay for machine time. The priority of a user can now be determined directly from the price at which the dial is set.

If the user becomes impatient, he need merely turn up his dial to a higher price setting. He is assured of immediate access to the machine provided he turns his dial high enough.

A device of this kind would be particularly useful for expediting short debugging runs. The total cost would be computed as the integral of the dial setting over the time used by that user, and would be quite small for short runs.

This method of assigning priorities would obviate the need for administrative priority assignment. It would de-centralize priority assignment in much the same way that economic decisions are de-centralized in a price-regulated economy.

The system could also be used within non-commercial computer installations. Thus, the present practice of allocating blocks of time to projects would be replaced by allocating blocks of value, i.e. the integral of the dial setting over time. An overriding crash program could be initiated by turning the dial up to a setting called "emergency."

Many variations on this theme suggest themselves. For instance, a commercial computer might have a minimum dial setting representing a lower limit on the cost of computer time. Time clocks could be attached to the dial, permitting deferred impatience. The requirement that a project be completed by a certain deadline could be met by adopting a dial setting policy to minimize the total expected cost of computer time subject to the deadline restriction.

Finally, a theory of a minimum cost dial settings could be developed for a given expected configuration of dial settings for other projects and a given time penalty. This problem would seem to be an example of an n-person game.

Research Techniques Division,
London School of Economics,
Houghton Street, W.C.2.

Yours, etc.,
PETER WEGNER

In Good Company

Sir,

I am sure that every member of The British Computer Society must be proud of the fact mentioned on page 49 of *The Computer Bulletin* for September 1961 that the word "The" not normally permitted by the Registrar of Joint Stock Companies as being too definitive, has been permitted to The British Computer Society.

Why, then, is the word "the" spelt with a small t in the ninth line of the second column of page 65 of the same issue of *The Computer Bulletin*? Incidentally, it may interest you to know that The British Computer Society is in good company; the correct name of the Law Society is "The Law Society."

Lamb Buildings,
Temple, E.C.4.

Yours, etc.,
WILLIAM PHILLIPS

Review Comment

Sir,

There is one error which I would like to correct, and some wording which may lead to a mistaken impression among some of your readers in the June review of our EDP Idea Finder. The price of the Idea Finder has always been $69. This included a free year's subscription (1960) to *Data Processing Digest*, in order to help purchasers maintain a continuous Digest service from 1957 where the Idea Finder begins. Recently, we have repriced the Idea Finder, and have offered some attractive combination prices with our other publications.

The mistaken impression about the Idea Finder may arise from the wording of the review which implies that these are original articles or complete reprints. The Idea Finder is meant to be a reference work only. There are only a few complete articles, written by our own staff. The remainder are brief or lengthy digests, depending on the type of article reviewed, its "digestibility," and frequently depending on the amount of digesting permitted by the original publication in which the complete article appeared. A complete list of publishers and their addresses is given to help the reader locate the original article for more complete information.

Thank you for the otherwise most gratifying review.

Canning, Sisson and Associates, Inc.
1140 *South Robertson Boulevard,*
Los Angeles 35, *California.*

Yours, etc.,
MARGARET MILLIGAN,
Editor, Data Processing Digest

ADDITIONS TO THE LIBRARY

Any enquiries relating to material appearing in this list should be made to the Honorary Librarian, F. C. Adey, F.L.A., Chief Librarian, Leicester Colleges of Art and Technology.

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LAW, H.
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Two Italian Banks Install Major Computer Systems

Two IBM 7070 computers have been installed in Italy, one in the Banco Popolare di Novara, near Milan, for payroll and general accounting, and the other in the Banco di Napoli for work on securities, guarantee deposits, current accounts and the centralisation of branch accounting. Both systems were manufactured in the United States and were airlifted to Italy from New York International Airport.

A Computer Library of Scientific Information

The Scientific Information Centre of the European Atomic Energy Community (EURATOM) is developing a computer program to enable an IBM 7090 computer to reply in the language of the enquirer, to any question of a scientific nature. With this program, the reading, analysis, translation selection and editing of all scientific information stored in the memory of the computer will be automatic.

PROGRAMMING LANGUAGE SURVEY

Committee TC 97 on Computers and Information Processing was formed by the International Standards Organisation at a meeting in Geneva in May 1961. The Committee has set up a number of Working Groups, among which Working Group E is concerned with programming languages. The US has the secretariat for this Working Group, under the direction of Dr. R. F. Clippinger of Minneapolis-Honeywell.

The first task to be undertaken by the group is to "collect documentation for, classify and catalogue the existing languages and their applications." Some of this information has already been collected for the US. The group now requests additional information from persons not already contacted. An extract from the existing charts is given below to illustrate the type and form of information required about each translator or compiler. However, additional information would be welcomed concerning languages of broad utility, in anticipation of a later survey giving more detail about selected languages.

The final survey will be published internationally when completed and approved. Because of possible publishing delays, information is requested immediately in order to be included in the final survey. Enquiries and information should be addressed to: R. W. Bemer, Survey Director, Working Group E, 112 East Post Road, White Plains, N.Y., USA.

Example

Language:		CLIP
Manual		
Publisher:		S.D.C.
Date:		Oct 1960
Pages:		18
Form No.:		TM 543
Translator		
Constructor:		S.D.C.
Machine:		IBM 7090
Configuration:		32K, 10 tapes, I/0, SOS System
Program Size:		18,000 instructions
Date Running:		June 1959
Translates Into:	(1)	A
Translation and Execution:	(2)	?
Applications:	(3)	A, M
Notes:		Algol-like, Character manipulation; used to write other translators.
Source of Information and Verification:		H. Bratman.

Explanations

(1) Translation may be from source language into:

A. A separate and named assembly language,
G. Machine language,
or I. An intermediate pseudo-language requiring interpretation at run time.

(2) Translation and execution may be:

A. Necessarily separate,
B. Necessarily consecutive (mandatory load-and-go),
C. At any time (optional load-and-go),
or I. Identical (by interpretive routine).

(3) Major applications may be:

A. Scientific
B. Business data processing
C. Control (real-time, process, tool, etc.)
I. Information retrieval
L. List handling
M. Symbol manipulation
N. Natural language processing and translation
S. Simulation.

Most Powerful EMIDEC 1100 Computer Delivered to BEA

The most powerful EMIDEC 1100 computer yet made was delivered on Wednesday, 4 October, to British European Airways head office at Bealine House, Ruislip. It includes the first model of a new 4096-word fast access core store, and eight magnetic tape decks.

BEA specified this extremely comprehensive computer to handle its unusually complex accounting system and statistical analysis. A large expansion in air travel and air-freight business is anticipated in the next few years, which could not easily be handled by present methods.

Another LEO Computer for Fords

The Ford Motor Co. Ltd., is to order another LEO computer, Mr. A. Bradley, Executive Assistant to the Managing Director, announced at the Electronic Data Processing Symposium in October.

Ford's are now using two LEO computers, one at Aveley Spare Parts Depot and the other at Dagenham plant. The new machine, a LEO III, will be installed at Aveley.

This was the second order to be announced for a LEO III during the course of the Computer Exhibition.

NEWS FROM MANUFACTURERS

Business Equipment Trade Association

Mr. Basil J. W. Coxeter was elected President for 1961–62 of the Office Appliance and Business Equipment Trades Association at the annual meeting in London last night (Monday, 30 October). Mr. Coxeter, who is 55, is a director of *Gestetner Duplicators* (*B.S.O.*) *Ltd.* He was educated at Clifton College and Peterhouse, Cambridge, and was a hockey international.

His election coincides with a decision to shorten the Association's name to "Business Equipment Trade Association."

The industry which it represents has increased its overall production in the past ten years from £25 million to £88 million.

Canadian Pacific

Six months of planning for an intricate moving day came to fruition on Saturday, 23 September, when Canadian Pacific took delivery of 20 giant-sized crates housing 13 tons of electronic equipment—the IBM 7080 electronic computer and related components. The most powerful commercial computer in the world, and the first of its kind outside the United States, the IBM 7080 will give Canadian Pacific the most advanced data processing installation in the transportation field.

When the railway inaugurated its integrated data processing system in 1957 the computer, which is at the heart of the coast-to-coast operation, was an IBM 705 Model I. It has since been replaced by the Model II and Model III 705's, each more powerful than its predecessor, as Canadian Pacific's activities in the data processing field expanded.

The commercial counterpart of the highly advanced computers used in scientific research and space rocketry, the IBM 7080 is fully transistorised and can produce management reports, process payrolls, and handle the great mass of data required in day-to-day railway operations up to six times faster than the 705 Model III now used at Canadian Pacific's Windsor Station headquarters in Montreal.

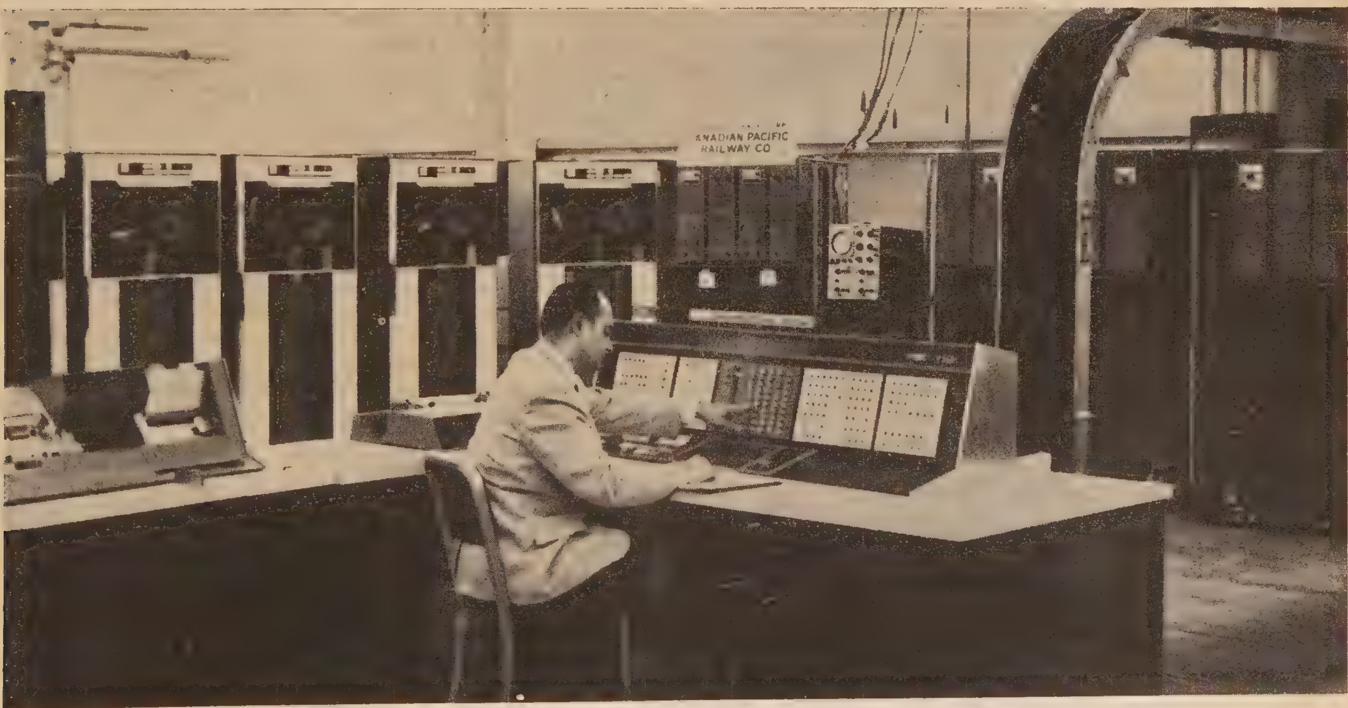
When in operation, the IBM 7080 will develop business information at tremendous speed. For instance, it can read in or write out 125,000 characters of information per second; it can make 333,000 logical decisions a second; it can add or subtract 78,000 six digit numbers per second or multiply 7,800 six digit numbers per second.

Canadian Pacific's IBM 7080, with the fastest "memory" available in a commercial computer, can transfer any one of 80,000 characters of information in one-millionth of a second.

To meet the insatiable appetite for data able to be processed at these high speeds, information is fed to the central processing unit of the computer through high-speed magnetic tape units reading 62,500 characters per second. Processed information is written at a similar high speed.

Due to its great flexibility, the IBM 7080 will be able to take up exactly where the 705 Model III computer left off. Canadian Pacific data processing officials say that the intricate programs which contain the instructions for the 705 Model III can be run on the 7080 without change. At present, more than 300 different programs are in use.

Each day, Canadian Pacific's integrated data processing system keeps track of between 80,000 and 100,000 individual freight car movements. Twice a month the complicated railway payroll process involving 80,000 pay cheques and the countless statements related to them are handled by the system.



Final testing of IBM 7080 Computer

With the new 7080, Canadian Pacific will be able to handle such major chores as these with consummate ease and further expand IDP operations as the need arises.

Decca Model 4000 *Magnetic-Tape Unit*

Decca Radar Ltd. have announced the following particulars of their new magnetic-tape unit, exhibited at the October Exhibition in London.

Absence of computer program restrictions, quietness in operation, the provision of automatic loading and unloading routines, simplicity in design and operation, and the absence of maintenance adjustments. Wide margins of performance and continuous rating of components are characteristics of the design, ensuring reliability, serviceability and freedom from scheduled or unscheduled maintenance.

Two versions of the unit with similar electrical and mechanical parameters are available for handling 1 in. and ½ in. magnetic tape. The standard cabinet contains one tape transport, electronic circuits, manual control panel with logical interlocks, head amplifier circuits and power and vacuum supplies.

Less than 2 milliseconds is required from the receipt of the start signal until the tape is running and remains running at the specified speed in correct registration with the head. At a tape speed of 150 in. per second the length of tape lost from use during starting and stopping is less than 0·3 in. Dual write/read heads are available at 0·39 in. spacing in order to provide for immediate check-back of recorded information. When this system is used a typical inter-block gap is only about 0·7 in. giving improved tape utilisation. Standard data rates are 45,000, 90,000 and 180,000 characters per second. The latter is achieved by an interlaced track arrangement, which also leads to a very high efficiency in the usage of tape by allowing the recording of twice as much data on a reel as compared with conventional methods.

The Type 4000 design incorporates pneumatic drive of the tape, a technique pioneered in the Decca 3000, and which is now being followed throughout the world. This technique permits rapid but smooth accelerations and decellerations to be achieved yet maintaining correct registration of the tape with the head. The new unit also employs large capacity bins as tape reservoirs giving ample time for smooth acceleration of the tape reel. The tape content of these reservoirs is automatically maintained between the necessary limits by a servo system employing an induction motor and saturable reactors. The tape unit is fully transistorised.

For full particulars apply to Decca Radar Ltd., Decca House, Albert Embankment, London, S.E.1 (leaflet reference ZW261 or later).

Addition to Ultra Range

Latest addition to the range of Ultra Electronics Automatic Business Equipment is a tape reader. A photoelectric system is used, and the machine accepts standard width 5-, 6-, 7- or 8-hole punched paper tape of varying thickness and colour. The side-entry method used for insertion of the tape permits simple loading and unloading of continuous tape loops. The operating speed of the machine is variable up to a maximum of 150 characters per second.

Also in the Ultra range is an Encoder Punch, recently shown at the Business Efficiency Exhibition, which produces a 5-hole paper tape. The machine has built-in coding facilities, the code being accommodated on a printed-circuit matrix which is pre-wired to suit individual coding requirements. The operating speed is a maximum of 10 characters per second, and standard 1,000 ft reels may be used.

Elliott Computer Achieves Significant Savings in Steelworks

By agreement with Samuel Fox & Co. Ltd., Elliott-Automation announces that the indications are that the Elliott electronic computer control of the billet cut-up line at Samuel Fox's steelworks at Stocksbridge, which has now been in use for six months, is fulfilling the expectations of the management.

The installation is the first application of an electronic digital computer to an actual steel process anywhere in the world and the first such application to any industrial process in the United Kingdom. At the time the installation was announced, it was said that significant cost savings were expected as a result of reduced wastage in the cut billets. It can now be said that the evidence so far available does show worthwhile savings in material yield.

Mr. P. F. Sutherby (EA Automation Systems Ltd.) reviewed this application during the BCS Conference at Harrogate in 1960 (see *The Computer Bulletin*, September 1960 Supplement, Vol. 4, p. 68).

Computer Speeds up Agricultural Payments

In the first twelve months of operation of the electronic computer of the Department of Agriculture and Fisheries for Scotland, more than 265,000 payable orders totalling approximately £20,000,000 were issued. Payments under the Fatstock Guarantee Scheme and the Cereals Deficiency Payments Scheme have been speeded up.

ICT Ltd. installed one of their Type 1202 computers in the Department's Automatic Data Processing Unit last year, when it was the first to be used by a Scottish Government department. It was officially started by the Secretary of State on 18 October 1960.

The machine was obtained for work in connection with the Fatstock Guarantee Scheme, the Cereals Deficiency Payments Scheme, agricultural statistics, and the payment of salaries and wages. A considerable amount of preparatory work was done before the computer was delivered and within a few weeks of its installation it was working on Fatstock Guarantee Scheme payments. In spite of an increase in the volume of work because of the greater number of cattle being presented for certification the service to producers has been maintained and payment speeded up. More than 200,000 payable orders for a total of approximately £12½ million have been issued during the year.

The first payments under the Cereals Deficiency Payments Scheme were made in December 1960. The advance and final payments for the 1960 Scheme were completed earlier than ever before. During the year 65,000 payable orders for a total of approximately £8,150,000 were issued.

The agricultural statistics in December 1960 were the first to be produced by the computer. It was also used for the machinery census statistics in February 1961, the pig statistics in March 1961, and the provisional statistics for June 1961. The final statistics for June are now nearing completion.

Work on the remaining scheme, the payment of salaries and wages to the staff of the four Scottish Departments, is now proceeding.

Rapid Data Transmission

Radio Corporation of America have announced the development of electronic equipment for transmitting data to a computer thousands of miles away at a pace many times faster than by teletypewriter. RCA magnetic-tape terminal units have been installed at San Francisco and Kansas City to send social-security data halfway across the United States from California to an RCA 501 computer system at Kansas City. Computer-processed facts and figures are relayed back to San Francisco the same day.

Mr. T. A. Smith, Executive Vice-President, Electronic Data Processing declared that the establishment of this new system will enable the San Francisco social security office to realise all the benefits of full-scale data processing by means of a computer 1,500 miles away. In this social security application, the use of economical public telegraph facilities limits the speed of transmission to about 40 times the speed of teletypewriter.

Data are transmitted between the two locations, which keep social security records, and certify benefit payment to the retired, widowed, and orphaned. RCA computers and data handling equipment are employed at the social security payment centres in Birminghan, Chicago, Philadelphia, and New York, as well as at Kansas City and San Francisco. In use, the equipment works with the Bell System's DATASET 201A at each end of the private line telephone circuit. The magnetic tape terminal was designed and developed by the West Coast engineering division of the RCA Electronic Data Processing Division's Data Communications and Custom Projects Department.

Data is relayed through the MTT's magnetic core memory to standard telephone, leased line, or microwave hookups. At the receiving end, the information once more passed through magnetic core memory and on to a magnetic tape unit for recording and computer processing. The use of core memory provides the highest rate of line efficiency by blanking out tape gap time.

The operator at the sending end of the line can dial the receiving point directly, receive confirmation that a connection has been established and start data transmission by pushing a button on the MTT control panel. Voice communications between sending and receiving operators is possible, without affecting the recording of basic data.

West German Chemical Works Installs Giant Computer

Huls Chemical Works in Recklinghausen, West Germany, has installed an IBM 7070 computer to handle all commercial accounting procedures, including a 10,000 men payroll which will be processed completely in 12 hours. Research calculations and the planning of new production capacity will also be handled by the 7070. Huls is the first chemical undertaking outside the United States to install a system of the size of the IBM 7070, which can complete more than 800,000 calculations per minute.

UNIVAC Announces New Solid State II Computer Featuring both Core and Drum Storage

The Univac Division of Sperry Rand Corporation have announced a new Univac Solid State II computer with both magnetic core and drum memory. This Univac Solid State II computer is the first produced in the United States to combine the benefits of core and fast drum memory in a medium-scale system.

Charles W. Elliott, Manager of Univac Computer Division in the United Kingdom, stated in October that "the integration of core memory with its speed and efficiency and economic drum memory with its extensive storage capacity on an ultra high-speed drum marks the first time the advantages of large scale computer multi-storage capacity have been offered in the medium scale computer price range.

"In terms of efficiency," Mr. Elliott said, "a total memory capacity expandable to 110,880 digits is more than sufficient to handle highly complex business operations in one computer run. Voluminous data-collection procedures that entail repetitive scanning, such as sales analyses or year-to-date payroll figures, fall easily within the scope of one-run processing. Nine index registers make possible the reduction of programme modification to simple, one-step procedures, while a new alphanumeric compare operation cuts non-numerical comparison time by 50%.

Volume and versatility are virtually unlimited. Two tape synchronisers and up to 20 tape servos enable simultaneous read-write, read-read and write-write operations. The Univac Solid State II is equally adaptable to punched card processing. Highly versatile, the system will accommodate 80 or 90 column cards, and plastic or metallic magnetic tape. In punched card processing, reading proceeds up to 600 cards, a minute; punching, 150 cards per minute; printing, 600 lines per minute—all operations being carried on simultaneously."

Information stored in the core memory can be accessed at the rate of 1·5 microseconds per digit. To move data between drum and core storage in the same access time per digit—up to 2,200 digits in a single operation—a new variable multi-word transfer feature is available. Outstanding features of the Univac Solid State II are:

14,080 digits of core.
28,600 to 96,800 digits of fast drum memory (17,670 r.p.m.)
Up to 2 tape synchronisers.
20 tape servos.
9 index registers.
Multi-word transfer: drum to core—core to drum.
Full alphanumeric compare.

The Univac Solid State II with drum plus core storage holds the key to:

One-run processing.
Straight-line programming.
Complete record transfer.
Complete internal summarisation and distribution.
Reduced comparison time.
Simplified programme modification.
Continuous, uninterrupted processing

and delivers in a compact, medium scale computer all the flexibility, capacity and speed heretofore found only in very large and more expensive systems.

Automatic Sales Accounting

An electronic computer ordered by Godfrey Phillips Ltd. at the Business Efficiency Exhibition in October 1960 is now producing invoices and credit notes at the company's head office in Commercial Street, London, E.1. This is some-

thing of a record in the business data processing field, where the gap between order and operation is often two or three years. The computer, delivered in July 1961, is a National-Elliott 803. It was the first 803 installation to be equipped with magnetic-film files. At present, the machine is doing work for Godfrey Phillips' two "paperback" publishing companies, Four Square Books and Ace Books. This involves the production of between 300 and 500 invoices per day. In December, the invoicing job will be integrated with the maintenance of customer accounts and the preparation of a wide range of management reports, and similar work will be undertaken for a third subsidiary company, Forget-Me-Not Cards. Future plans include stock control and the compilation of leaf clearing statistics for the cigarette and tobacco business.

For the integrated sales accounting system, the sales ledger will be held on reels of magnetic film. At the beginning of the run, title records (consisting of title code numbers, prices and current stock levels) will be stored, with the program, into the 803's unusually large magnetic core memory. The basic details of new orders (customers' code numbers, title numbers and quantities) are fed to the computer in the form of punched paper tape. The computer considers each order in turn and automatically updates both the customer's account data on magnetic film and the stock level data in the core memory.

Information required for invoicing is simultaneously punched into tape for subsequent reproduction on automatic typewriters. Other types of output include a "danger list" of titles which have dropped below their predetermined stock levels, and a summary of the day's operations.

For the production of monthly statements, the computer extracts the necessary data from the cumulative records stored in the magnetic-film ledger.

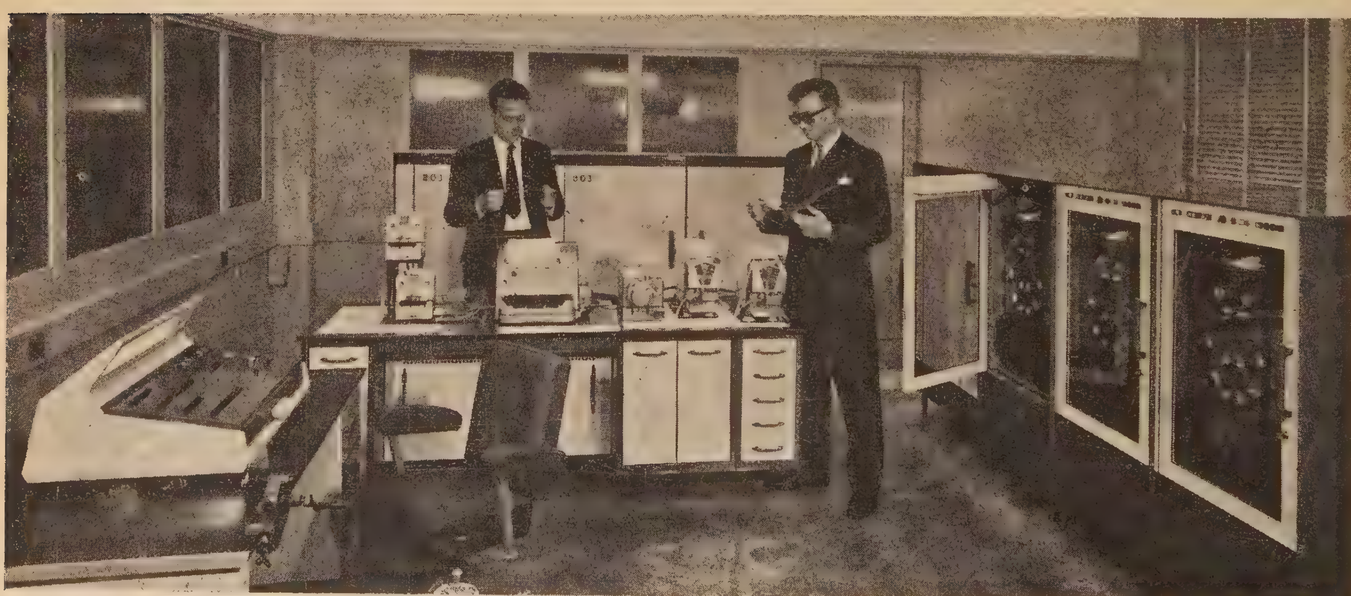
Godfrey Phillips are placing great emphasis on the regular analysis of sales accounting and other data. In 1962, the 803 will start to produce a whole series of monthly reports, including summaries of home and export sales, returns and stock balances, and analysis of sales by representative and type of retail outlet. These summaries will be compiled from data accumulated as a by-product of the day-to-day invoicing and stock recording operations.

One very important function of the computer will be to calculate the rate of sale of each title and from this predict how long the current stock will last. Godfrey Phillips believe that this information will enable reprinting schedules to be planned far more efficiently than at present. The rate of sales calculations will involve even titles awaiting publication, thus enabling reprinting to be put in hand at an early stage if the demand for any new book is heavier than anticipated. At the same time, the computer will produce a monthly stock "danger list" and will sort the full range of titles into different "rate of sale" groups.

Another monthly task will be to calculate the royalties due to each author and to produce the necessary documents.

In the past, much of the accounting work was done on conventional punched card equipment. The computer will not only save time and labour on the daily routines, but will make available to management a much greater quantity of up-to-date information than was previously possible.

One reason why the project has developed so quickly is that the National-Elliott 803 computer is exceptionally easy to program. In setting up this operation, Godfrey Phillips were able to recruit programmers from their own staff. The National-Elliott 803 computer is manufactured at the Borehamwood, Herts., factory of Elliott Brothers (London) Ltd. For use as an electronic accounting and business data processing system, it is marketed, installed and serviced by the NCR Electronics Group of the National Cash Register Company Ltd.



National-Elliott 803 EDP System

ICT–RCA Agreement

International Computers and Tabulators Limited announce an agreement with the Radio Corporation of America for the non-exclusive exchange of technical information and patents in the field of data processing.

ICT's substantial research and development activities will continue, and its progress in these directions will now be extended and accelerated through the exchange of technical information under the new agreement. The arrangements between these two major international companies herald important advances for the electronic data processing industry, and will permit reciprocal purchase of equipment where this appears desirable, thus enabling ICT to expand its range of computing machines.

International Computers and Tabulators Limited is Britain's largest manufacturer and distributor of punched cards and electronic data processing machinery. The company, whose net assets exceed £40 millions, has fifteen subsidiary and associated companies and operates in fifty-one countries.

ICT offers the world's widest range of punched card data processing equipment, and manufacturers and markets a variety of electronic computers, ranging from the smallest machines to the latest Type 1301 magnetic tape system. Its products are extensively used by central and local governments, nationalised industries and public corporations, as well as by large numbers of commercial and industrial undertakings of all sizes.

The company employs over 21,000 people and its 23 manufacturing premises in Great Britain have a combined production area of over two million square feet.

Radio Corporation of America is one of the world's largest electronic engineering organisations. It employs in total some 88,000 people, of whom nearly one quarter are engaged in research, development and manufacture of electronic devices and components for the Corporation's wide range of industrial and commercial products.

RCA embarked on its first research into EDP equipment in 1949. Two years later the Corporation received its first contract from the US Ordnance Corps for a large-scale computer system. Now it is one of the principal suppliers of data processing equipment in America, manufacturing commercial and scientific computer systems, industrial automation equipment, and data collection and transmission systems.

ATLAS *Computer for London University*

A great acceleration in the pace of Britain's scientific research will become possible with the installation at the University of London of the Ferranti ATLAS—towards the end of 1963 at a cost of approximately £2 million. This machine is claimed to be the most powerful computer in the world. Computers of this size are urgently needed by British universities to meet the ever-increasing volume of computation involved in present-day research projects.

The University of London computing system is the third ATLAS to be ordered. The first production model is at present being assembled and commissioned at the University of Manchester and will be available for use early next year. A second has been ordered by the National Institute for Research in Nuclear Science, and will be in operation at Harwell in 1964. When these three machines are in operation, universities in Britain will have exceptional opportunities comparable to those available in the United States and elsewhere, and should be able to make a considerable contribution to the national effort during the next few vital years.

Initial support is being given to the University of London by the British Petroleum Company, which is providing approximately a quarter of the cost. In return, British Petroleum will have an agreed amount of time on the London ATLAS for a period of five years, and they plan to use it for the full-scale integration of their refinery and supply programme.

Responsibility for the University of London machine will be taken by the University's Computer Unit, situated in Gordon Square, W.C.1. This provides computing facilities for all colleges of the university and for many other outside organisations, and has been operating with a Ferranti MERCURY Mark II computer since 1959. Although the MERCURY was one of the fastest machines available in Europe when it was installed, it is now inadequate to cope with the size and range of computations required by the University.

The ATLAS computer is not only expected to be nearly 100 times faster than MERCURY but has a much greater capacity for handling numbers, and also has facilities for storing large quantities of data on high-speed magnetic tape units. The lack of magnetic tape facilities on the University's present MERCURY installation has severely restricted work on problems requiring the analysis of data resulting from research studies.

ATLAS has been developed in co-operation with the University of Manchester. It is designed as a general-purpose machine for both scientific calculation and data processing. Original technical features include a supervisory system for regulating the flow of work through the machine, a "page-address" system for more efficient utilisation of storage space, a new type of semi-permanent store for frequently required data, and an adder with exceptionally fast carry-over. Simple instructions (e.g. addition) can be performed at a speed approaching a million per second.

UNIVAC in Manchester

We have received an official announcement of the opening of a Univac Computer Division office in Manchester. The provisional schedule calls for delivery of a Univac Solid State 80 computer in the third quarter of this year and the machine to be fully operational early in 1962.

Due to the high degree of industrial expansion in the Manchester and Liverpool areas and the corresponding interest in computing systems, it seemed essential that a Univac Centre be established to cope with this increasing demand. It will cater for the surrounding territory including Leeds, Sheffield, Birmingham, Nottingham and will form the base for activities throughout the Northern area, including Scotland. The Univac Computer Division office will be fully staffed on all levels and will operate as a self-contained unit under Head Office in London.

The recruitment programme is almost complete and staff is now undergoing training both in London and Manchester. Additional fully experienced staff is being transferred from the London office.

The USS-80 computer will be used initially for demonstrations and training of Univac and customer personnel.

Data Transmission and Remote Data Processing

At the end of August a STANTEC electronic computer in Harlow, Essex, was operated over a leased GPO telephone line

from Aldwych, London, a distance of some 30 miles, in a demonstration by Standard Telephones and Cables Limited, of data transmission and processing. Using equipment in STC's Headquarters in Aldwych, London, the STANTEC computer in Harlow was fed with problems set by visitors in London, the answers being returned and printed out there.

During September, the remote end of this demonstration was moved to Paris and was again used to pass data to the Harlow Computer for processing. In October, a further move enabled visitors to the Electronic Computer Exhibition to operate the computer from the STC stand at Olympia.

The data transmission systems demonstrated were taken from a range to be marketed by STC and its associated companies to meet the requirements of industry and commerce. They are designed for centralised accounting, banking, stock control and invoicing; for linking computers and local service centres; for multiple and chain stores; for electronic seat reservation systems. Ranging from manual speed systems for applications where the amount of information to be transmitted is low, to medium speed systems for high density traffic, and incorporating automatic error detection and correction, this equipment is compact and easy to operate.

The systems use standard GPO lines. Data transmission links can be established on either telegraph or telephone circuits, to provide a rapid exchange of data between widely separated data handling machines and thereby eliminate the cost of delays associated with the physical carriage of data. Low speed links normally use telegraph circuits, but for higher speeds of transmission the wider frequency band available on telephone circuits is necessary. With the appropriate equipment, signalling speeds of 1,000 bauds (1,000 data "bits" per second) or more can be achieved on suitable telephone circuits.

In these demonstrations the data source—a punched paper tape reader in London—and the Harlow computer were interconnected by a leased four-wire telephone circuit. The computer was pre-programmed to provide the following facilities:

(*a*) The summation of numbers.
(*b*) The determination of the arithmetical mean of a batch of random numbers.
(*c*) The sorting of random numbers in ascending order.

The requisite instructions for selecting the program appropriate to the problems were punched on the source data tape.

A five unit code was used in preparing the tape. The output from the tape reader was fed to the logic equipment and there converted from parallel to serial mode, with two data "bits" added to each character for parity purposes. The data output from the logic equipment was applied to a data transmission unit connected to the GPO line to Harlow. The transmission speed was about 1,000 bauds. At the computer centre, each received character was automatically checked, reconverted to the parallel mode and passed to the computer where it was processed in accordance with the pre-selected program.

If a character was incorrectly received at the computer an indication was given to the sending end and the complete message was re-transmitted.

Standard Telecommunication Laboratories, with the active co-operation of the British Post Office and other telephone administrations, have been conducting extensive investigations into the problems associated with the transmission of data signals over switched and leased telephone and telegraph networks. The information so obtained is being used in the design of a range of data transmission systems to meet the diverse requirements of industry and commerce.

An operator starts sending data over a leased telephone line using typical data transmission equipment. On the left is the data transmission "modem" which is connected to the telephone line. In the foreground is a paper tape reader, from which the 5-channel parallel information is taken to logic equipment contained in the desk for conversion to the serial mode before transmission via the modem.

The telephone is used to establish the call. When a button on the telephone is pressed, the line is switched to transmit data signals.

Card-to-Tape Converter Steps Up Data Handling Rate

The Card/Tape Converter developed by EMI Electronics Ltd. for use with the EMIDEC 2400 computer, which will process data for the Government Graduated Pension Scheme, is now in successful operation at the Newcastle Headquarters of the Ministry of Pensions and National Insurance. It is taping individual records at the rate of up to 1,000,000 per week.

The EMIDEC 2400 can read original data from punched cards or paper tape, but it reads the same information from magnetic tape at forty times the speed. Hence, to conserve computer time, the system includes a card/tape converter which transfers information from punched cards to magnetic tape while the computer itself is fully engaged on a separate task.

Use of this converter is exemplified in the MPNI's EMIDEC 2400, whose task is essentially to record contributions made to the Graduated Pension Scheme. Before this process can commence, a magnetic tape file has to be produced containing personal details of 26 million persons.

The reverse process is also employed. The computer is required to produce punched cards, a process three times slower than reading them. The computer merely writes the information on to magnetic tape which is subsequently translated by the converter into punched cards.

These two independent processes of conversion, cards to magnetic tape and magnetic tape to cards, can be carried out concurrently by the one card/tape converter.

Ultimately the converter will save about five hours per day of computer time in its reading operations, dealing with benefit enquiries, amendments to files and notification of 30 million contribution entries per annum. In its writing operations, it will save over two hours computer time per day when punching out cards for selected items from the files, and for entries queried by the editing programs.

SEPSEA

La Société Pour L'Exploitation des Procédés S.E.A. of Puteaux (Seine) has announced, in connection with the International Salon of Office Equipment held during October in Paris (SICOB), that it exhibited two sets of data processing equipment.

SEA 3900. Fully transistorised, with simultaneous operation of reading from and writing on to magnetic tape, during processing. Card reader 600 per minute; paper tape reader 450 characters per second; printer at 900 lines per minute in alphanumeric characters or 1,400 lines in numeric characters. Central unit handles alphanumeric data in variable length with simultaneous input, output and calculation, thanks to its two channels of access to the ferrite-core working memory (6μ sec per double character; capacity 4,096, 8,192 or 16,384 characters).

Magnetic-tape units with transfer-rate 9,200 double characters per second; possibility of connecting 9 units or up to 18 with supplementary control unit.

Control unit with own memory (1,024 characters) permits editing operations to be performed autonomously during transfer from magnetic tape.

New features include simultaneous reading from 2 magnetic tapes, "lecture-anière" of magnetic tapes and concentration of data on magnetic tape.

CAB 500. A small electronic calculator. Capacity 16,384 words of 33 bits, each equivalent to 10 decimal digits or 5 alphanumeric characters. Additional programming facilities have been incorporated in the last year; this equipment was very popular at the French Exhibition in Moscow. Intended for scientific and technical applications, or use in businesses where several data processing centres are necessary.

SEPSEA was formed in 1959 by la Société d'Electronique et d'Automatisme (SEA) of Courbevoie (Seine), by the group Gaz et Eaux, la Société Le Material Electrique SW, and various companies of the Schneider group. During the past year it has installed more than 50 electronic installations.

Readers desiring further information should write to SEPSEA, 36, Quai Nationale, Puteaux, Seine, France.

Detergent Company to Set Up Data Processing Centre

Thomas Hedley and Co. Limited, the soap, detergent and edible fat manufacturers, are to set up a data processing centre at their Newcastle upon Tyne head office. It will be equipped with one of the latest electronic computing systems, the NCR 315. The centre will be developed to provide a variety of services for Hedley's commercial and scientific departments. These will include scientific calculations for the company's engineers and research chemists.

The decision to install a computer has followed the success of a data processing centre set up in the United States about four years ago by the parent company, Procter and Gamble.

One of the unique features of the NCR 315 system chosen by Hedley is the electronic memory called "Cram." In this, information is stored magnetically on plastic cards, any of which can be selected and read by the computer in a fraction of a second.

Random Access Storage

Random access storage equipment, using magnetic discs, for their type 400 medium-scale computer, is announced by Honeywell Controls Limited.

Four models are available, ranging from a minimum capacity of 24 million alphanumeric characters using 6 discs to a maximum of 96 million characters using 24 discs. Average access time to any item in the file, regardless of file size, is approximately 100 milliseconds, with maximum access time 170 milliseconds.

Each magnetic disc is divided into several zones for recording purposes. The outermost zone will send or receive data at a rate of about 8,000 words per second on a continuous basis. The innermost zone has a transmission rate of about 3,000 words per second. Transmission proceeds bit by bit, character by character, and word by word. The random access unit controls all searching, reading and recording operations on the entire disc file. It also controls all file switching, head selection and information checking. All information in the disc files is subject to a high degree of error detection and automatic correction for all information read from the random access files.

It is permissible to have a full complement of eight magnetic tape units connected to the Honeywell 400 concurrently with any one of the four random access units. Other input and output devices may also be used, including card readers and punches, paper tape readers and punches and high-speed printing equipment.

Fast Computer is Ergonomically Designed

Only speaker on the application of ergonomic principles to computer design at the International Ergonomics Conference, held in the autumn in Stockholm, was Brian Shackel, M.A., of the Psychological Research Laboratory at EMI Electronics Ltd.

Mr. Shackel spoke of the part he played in the design of the EMIDEC 2400—one of Europe's fastest and most powerful all-transistor computers.

"A general-purpose digital computer does not have one fixed sequence of operations," Mr. Shackel pointed out, "but a multitude of subroutines and functional modes. Its operating is largely controlled by the program in use at the time. So the console is a sophisticated monitoring station, with manual control facilities, accompanied by some diagnostic and fault-finding sections.

"The correct design philosophy must be to group together associated displays and controls, and to locate panels by relative importance and frequency of use, rather than to seek a comprehensive sequential layout."

Colour of lettering, shape of knobs and distance from operator's seat to furthermost control were just three of the many factors to come under the ergonomist's scrutiny. Ringing bells and Friedland chimes were introduced to reduce the number of visual alarms needed. A window on to the outside world from the computer building was recommended, as a means of relaxing operators' tension towards the end of a difficult day.

EMI Electronics claim to be the first European computer manufacturer to design with the full use of ergonomic principles.

IBM 1001—*A New Low-Cost Data Transmission System*

New equipment which will transmit data from punched cards over private internal telephone lines to a receiving automatic card punch has been announced by IBM United Kingdom Limited. The IBM 1001 Data Transmission Unit has been developed as a low-cost means of fast, accurate reporting to a central point from many information sources within a private network. Such applications would include hospital charge reporting, centralised payrolls, manufacturing process reporting, inventory control and reporting from sales counters to the central office of a department store.

The IBM 1001 Data Transmission Terminal has a ten-digit keyboard and a card carriage with fixed 80, 51 or 22 column feed.

The sender dials the number of the receiving card punch on his telephone, to which the 1001 is attached, and receives a signal to indicate that the punch, attached to the distant telephone, is ready to receive. Connection and subsequent disconnection are both fully automatic. An IBM card is inserted into the carriage and data contained in the first 22 columns is transmitted at a speed of 12 columns per second. The sender then keys in the variable information which is simultaneously transmitted. When the sender depresses the register key, releasing the card, he immediately receives a signal from the distant receiving station, through the 1001, that his data has been received, in punched-card form, ready for input without further operations to the central data processing installation.

National Provincial Bank

International Computers and Tabulators Limited's first order for the new National Data Processing Corporation's Electronic Document Processing System has been placed by the National Provincial Bank.

The National Data Processing Corporation of Dallas Texas, are makers of document handling equipment designed for bank automation. ICT concluded a long-term marketing and manufacturing agreement with them in May of this year.

The Bank is to rent equipment with a capital value of approximately £85,000 for initial use in sorting cheques to branch order and automatically listing the amounts encoded in magnetic ink. Experiments in cheque-sorting techniques are also envisaged by the Bank staff.

The equipment, which is to be installed in the Bank's London Clearing Department in November 1962, will consist of a document processor and audit lister. Document encoders for printing magnetic ink characters on cheques will also be required.

The principal machine in the system is the document processor—basically a paper document sorter with 18 pockets —which reads and sorts cheques at a constant speed of 1,200 documents a minute. The tolerance of the processor's vacuum feed admits intermixing of card and paper documents of varying weights and sizes. Check digits on account numbers, etc., may also be proved without interrupting processing. The control panel of the processor permits a considerable amount of selective or program sorting.

The audit lister, linked to the document processor provides the means for accumulating, proving and printing information read from documents in the processor. The audit lister has two modules—the printer, operating at 1,200 lines a minute, and the arithmetic unit for the accumulation of totals and recognition of control documents.

Electronic Plotting Machine

An electronic plotting machine is doing the work of a staff of draughtsmen in New York, automatically preparing large quantities of highway cross-section drawings for new road projects, much the same as artists prepare large quantities of drawings for a new Hollywood motion picture cartoon.

The distinction of being the first professional engineering firm in the USA to turn this most tedious of draughting-board drudgeries over to electronics belongs to King and Gavaris, consulting engineers on State and Federal highway projects. The firm uses a model 3300 DATAPLOTTER, designed by Electronic Associates Inc., parent company of Electronic Associates Ltd., to prepare cross-section drawings for every 50 ft of planned highway, a standard requirement on such new construction projects.

In a normal working day, the plotter will do the equivalent work of half-a-dozen draughtsmen preparing the myriad of drawings on 30×30 in. sheets of graph paper. These drawings are required by engineers to enable them to determine the exact details of the road-bed area, elevation, cut-and-fill earthwork requirements and drainage problems in designing a new highway. On a new road project, all the data normally prepared by cross-section draughtsmen is prepared instead by an electronic computer on punched paper tape which serves to instruct the plotter in its job of preparing the large volume of drawings automatically.

The plotter has been used on more than a dozen highway construction projects in the east and mid-west of USA and will turn out more than 400 cross-section drawings in a normal working day.

On a typical project, field notes and aerial photographs are first obtained and then mathematically evaluated and programmed on a digital computer for the plotter. The information from the computer is prepared in numerical form on punched paper tape and fed to the plotter where it is converted from digital to analogue impulses. These impulses then control a mechanical "hand" which guides an inked stylus in drawing the cross-sections, one after another, on the plotting board. The results are in every respect similar to those formerly drawn by hand, and the firm also has developed a system for using the plotter to plot vertical highway profiles and horizontal traverse surveys.

With the computer, it is possible to compute traverse surveys faster than the average engineer can assemble the data. This offers the opportunity of getting answers back to the field and keeping a construction team on location working continuously without any interruptions for field computations.

Similarly, with the plotter, engineers no longer have to wait for periods which have been known to extend to a full month before cross-sections are available for use in proceeding with important design work.

An IBM Stretch Computer for the UKAEA

The contract for an IBM STRETCH computer, to be installed with the United Kingdom Atomic Energy Authority in 1962, was signed in London in September.

IBM 704, 709 and 7090 computers for solving mathematical and scientific problems have been installed with UKAEA since 1957. Of other STRETCH systems on order, the first to be built was installed earlier this year and is now working at Los Alamos Scientific Laboratory which is operated for the US Atomic Energy Commission by the University of California.

UNIVAC Step Installation for William Timpson Ltd.

In March 1962, a Univac STEP computer installation consisting of:

A Central Processor with 30,000 digits memory (including 6,000 digits of high-speed access memory);
A Tape Synchroniser;
4 Uniservo II tape units;
A 450 cards/minute High-Speed Card Reader;
and a 600 lines/minute High-Speed Printer,

will be delivered to the premises of William Timpson Ltd. at their retail headquarters in Manchester. This will be the climax of 12 months of intensive systems analysis and programming which began in March 1961 when three Timpson executives visited the Univac Solid State 80 computer installed at Remington House.

Under the present schedule the first tasks to be transferred to Univac STEP will be the control of warehouse stocks and the invoicing of stocks sent from the warehouse to the 260 Timpson retail shops. This will enable Timpson's to re-deploy to other important work 14 accounting machine operators. The next task to be taken on by the computer will be the control of individual shop stocks.

Memory Storage Unit for Analogue Computers

Electronic Associates Inc., parent company of Electronic Associates Ltd., has announced the first commercial sale of a general purpose analogue computer equipped with a newly developed component that adds a high-speed memory storage capability. The memory component called *Microstore* is transistorised and extremely compact, and has been under development and used experimentally for nearly a year. The commercial sale was made to a major American chemical company, for use in the study of chemical processes and associated control systems.

Microstore is an analogue computer component which can store answers or result values, for presentation later when the operator wants to compare new values to those previously computed. Two values at a time can be stored in one memory package for recall later. Up to 10 *Microstore* components, each containing two storage units, can be plugged into a PACE 231R general purpose analogue computer without disturbing the use of existing summing amplifiers.

Elliott Brothers (London) Ltd.—Special Computer Division

The formation of a Special Computer Division within the Data Processing Group of Divisions of Elliott Brothers (London) Limited has been announced in a statement by Elliott-Automation Limited.

The new Division, under the leadership of Mr. S. L. H. Clarke, Assistant General Manager of Elliott Brothers, specialises in tackling the problems associated with the "on-line" application of digital computers to continuous operations. No great amount of work has yet been done in this field anywhere in the world, with the result that there are many fundamental studies to be carried out in developing the new techniques required. Not least of the problems is that there may be a wide range of sources of information, such as radar signals, relayed radio messages, teleprinters and instruments of many kinds, in addition to manual keyboards, all feeding data to a computer simultaneously, while at the same time it is providing outputs in the form of visual displays, command signals and the automatic logging of data. The complexity of such systems is very great and has given rise to the need for the formation of special teams of experts to study them.

The Division is at present engaged upon the development of an experimental Air-Traffic Control System, an advanced airline seat-reservation system, and the control and switching of telegraph communications networks.

Shell-Mex and BP Ltd.

It was announced during the Computer Exhibition that Shell-Mex and BP Ltd. have ordered a LEO III computer. This brought the total number of LEO III computers already ordered for operation in 1962 to five.

Other users will be: CAV Ltd., the Dunlop Rubber Co. Ltd., and Leo Service Bureaux in London and Johannesburg.

Hornsey Borough

The Borough of Hornsey, Middlesex, has ordered a STANTEC electronic data processing system to take over the payroll for its 600 weekly-paid employees; the stores records for over 2,000 commodities; council expenditure accounting; and the billing for the rates. It is intended to use the equipment later in a comprehensive rates system, which will be kept up-to-date on such facts as changes of occupier and variations of assessment and allowances. Records of payments will also be kept and the computer will be able to pick out those people who have not paid their rates, and to print reminders, seven-day notices and, for the really "hard cases," summonses.

Local authorities generally, faced with an ever-increasing demand for additional services, coupled with rising costs, are finding that it is only by adopting up-to-date administrative methods that they can increase their efficiency and thereby keep their demands on the ratepayers within reasonable bounds. Nevertheless only a few of the larger authorities have yet ventured into the field of electronic data processing, hitherto considered to be beyond their means.

Hornsey, with about 100,000 inhabitants, is therefore very much a pioneer in deciding that a borough of its size requires a fully-integrated electronic system. Mr. E. C. Lay, the Borough Treasurer, has always taken a keen interest in electronics. The Computing system to be supplied will consist of a basic STANTEC computer, fully transistorised, with a large main store of 8,192 "words"; paper tape preparation equipment; a Creed high speed mosaic printer; and a Creed paper tape store with monitor teleprinter. The computer contains the circuits to control additional units should expansion become necessary. It is planned to transfer work to the computer in stages, the first jobs being those at present mechanised on punched card or keyboard machines.

Conventional records will largely be replaced by punched paper tapes, and the Creed paper tape store is being installed in the public office to enable speedy reference to be made to any item. Any required block of information can rapidly be selected and printed out from the tape store merely by dialling a number on an ordinary telephone dial.

Coutts & Company, Bankers

The Univac Computer Division of Remington Rand Ltd., have announced an order from Messrs. Coutts & Co., Bankers, for the installation of a Univac Solid State 80 STEP tape computing system in the spring of 1962.

The computer will initially be used for customer ledger accounting, for current, deposit and loan accounts, including all interest calculations, and the handling of standing orders. Customers' statements produced by the computer will include a full description of transactions, as under their present system. This was stipulated by Coutts & Company as a basic requirement of the system and has been fully complied with. Future plans include the production of various statistical returns, travellers' cheques accounting, registrar and securities application.

The computer installation will include the central processor with 28,600 digits of storage, high-speed card reader, read-punch unit, a 600 line per minute high-speed printer and two tape units. The basic input will be punched cards produced by IBM key printing punches linked to Addo add-listing machines and with built in modulus II check. Statements, daily balance lists and all other printed out-put will be produced on-line by the high speed printer.

The decision to purchase a Univac computer was made after a full investigation of all types of computing and punched card equipment available and major factors in that decision were the proven reliability and the widespread use of the Univac USS-80 in the banking field, both in the USA and on the Continent. Members of the staff of Messrs. Coutts & Company who form the basis of the newly established Data Processing Department have completed a programming course at Remington House and are currently engaged in systems analysis and programming. They are being assisted by specialised Univac staff, who were responsible for pioneering the first current account book-keeping computer programmes which they demonstrated in Europe in 1958.

Messrs. Coutts & Company's Data Processing Department will eventually take full control of the computer operation and its expanding area of functions in the Bank's work.

ESSO Petroleum (Ireland) Ltd.

Esso Petroleum (Ireland) Ltd. have just placed an order with International Computers and Tabulators Limited for their new Type 1301 Electronic Computer, now being shown for the first time at the Electronic Computer Exhibition in London. The machine which has a capital value of £70,000 will be installed in 1963. Esso Petroleum (Ireland) Ltd. have been users of ICT punched card, data processing equipment for the past nine years.

The computer is to be employed for sales accounting, payroll production and for general accounting including control of fixed assets and stocks, the preparation of statistics, pension fund accounting, and investment analyses.

The principal feature of the 1301 electronic computer is its high processing speed combined with its exceptionally large capacity. The system has been specially designed to permit development and expansion along with the growth of the organisation and the management requirements it is intended to serve. Advanced logical design and the incorporation of solid state techniques afford maximum efficiency and economy and a high productivity rate at minimum cost.

The ICT 1301 operates with punched card and/or magnetic tape input and output as well as printed output at 600 lines per minute. The rate of program-controlled punched card input is 600 cards per minute; and up to eight magnetic tape decks can be incorporated in the system. Two magnetic tape systems are available—the standard system (½-in. tape operating at 22,500 digits per second), and the high-speed system (1-in. tape operating at 90,000 digits per second).

An immediate access core store has a basic capacity of 400 words each of 12 digits capable of being expanded to 2,000 words in multiples of 400 words. This is backed by a drum store holding 12,000 words of 12 digits and able to be extended up to 96,000 words in multiples of 12,000.

The fully transistorised central processor operates at 1,000,000 cycles per second. Decimal or sterling addition and subtraction are executed in 21 microseconds, and for multiplication the average is 170 microseconds per multiplier digit.

IFIPS

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ORGANISATION

What is IFIPS?

The International Federation of Information Processing Societies is a permanent world organisation representing the technical societies of 17 nations. Each member of the Federation's Council represents his nation's technical societies active in the information processing field.

The information processing sciences include the mathematical and engineering aspects of communicating information between men and machines. While computers have gained the greatest recognition as being representative of information technology, the scope of this broad field includes equipment and techniques for the collection, transmission, translation, storage, retrieval, reduction, and display of information, usually by automatic means.

What is the Background of IFIPS?

Although the field is only approximately 15 years old, information technology already has become a multi-billion dollar business with far-reaching effects on all nations of the world.

Until 1959, there was no permanent international body devoted to the information processing sciences. Then, in June 1959, activities surrounding the UNESCO-sponsored first International Conference on Information Processing acted as a catalyst for the formation of such a group. Representatives of the pre-eminent computer societies of 18 nations, acting as private but highly placed individuals, held a constituent meeting to form a Provisional Bureau. The effects of its existence were quickly felt. In some countries lacking firm national organisations, appropriately active technical societies were formed to serve the information processing field and to qualify for admission.

The Statutes of the International Federation of Information Processing Societies were ratified in January 1960, and IFIPS thus joined the ranks of similar international organisations serving such vital sciences as geodesy, astronautics, radio, medicine, astronomy, physics, chemistry, etc.

Who are the Officers of IFIPS?

At its first meeting, in Rome at the Provisional International Computation Centre, the Council of IFIPS elected its officers:

President — Mr. Isaac L. Auerbach (representing the National Joint Computer Committee, USA)
Auerbach Electronics Corp.
1634 Arch St.
Philadelphia 3, Pa., USA

Vice-President — Prof. Dr. A. Walther (representing Deutsche Arbeitsgemeinschaft für Rechen-Anlagen (DARA), Germany)
Technische Hochschule
(16) Darmstadt, Germany

Secretary-Treasurer — Dr. Ambrose P. Speiser (representing the Swiss Federation of Automatic Control, Switzerland)
IBM Research Laboratory
Zurichstrasse 108, Adliswil-Zurich, Switzerland

Mr. Auerbach is president of Auerbach Electronics Corporation, Philadelphia 3, Pa., USA. Prof. Dr. Alwin Walther is associated with the Technische Hochschule, Darmstadt, Germany. Dr. Ambrose P. Speiser is Director of the IBM Research Laboratory, Adliswil-Zurich, Switzerland.

What Will IFIPS Do?

Besides the organisation of international conferences, the activities of the Federation will consist of co-ordinating standards in the field of information processing. Other projects will be assumed by the Council, as requested by the national technical societies, to help the growth of the information processing field.

Who are the 17 Member Nations of IFIPS?

Australia	Australian National Committee on Computation and Automatic Control
Belgium	Association Belge pour l'Application des Methodes Scientifiques de Gestion
Canada	Computing and Data Processing Society of Canada
Czechoslovakia	Commission for Technical Cybernetics, Czechoslovak Academy of Sciences
Denmark	Danish Academy of Technical Sciences
Finland	The Finnish National Committee for Information Processing
France	Association Francaise de Calcul (AFCAL)
Germany	Deutsche Arbeitsgemeinschaft für Rechen-Anlagen (DARA)
Japan	Information Processing Society of Japan
Netherlands	Nederlands Rekenmachine Genootschap
Poland	Polish Academy of Sciences
Spain	Instituto de Electricidad y Automatica
Sweden	Swedish Society for Information Processing
Switzerland	Swiss Federation of Automatic Control
United Kingdom	The British Computer Society
United States	National Joint Computer Committee*
USSR	Academy of Sciences of the USSR

* To become AFIPS (American Federation of Information Processing Societies).

IFIPS COUNCIL SPEEDS PLANS

The Council of the International Federation of Information Processing Societies, at a meeting just concluded in Darmstadt, Germany, has agreed to convene an international conference to be known as *IFIP Congress* 62, in Munich, Germany, August 27–September 1, 1962.

In other business conducted by the IFIPS Council, President Auerbach appointed Professor Dr. A. van Wijngaarden as Chairman of the *Finance Committee* for IFIPS. Professor Wijngaarden, the Netherlands delegate representing Nederlands Rekenmachine Genootschap, is associated with the Mathematisch Centrum in Amsterdam.

Professor M. Linsman, of Belgium, has been appointed Editor of the IFIPS *Bulletin*. He is associated with the Centre Interdisciplinaire de Calcul of the University of Liége.

Mr. B. Langefors was appointed Chairman of the IFIPS *Admission Committee*. Mr. Langefors is associated with the Matematikmaskinnamnden in Stockholm, Sweden.

STANDARDISATION IN COMPUTER FIELD FOSTERED

This is the first time that a summit-level effort has been organised in the burgeoning information processing sciences to resolve the problems of terminology and symbology resulting from the independent growth of information technology in many lands.

In the past, many technical societies individually have done standards work on different aspects of information technology. They also have sent representatives to national standards groups. While some international standards discussions have been held previously by various national groups, this is the first international standards endeavour in the computer field undertaken by a technical world body directly representative of the information processing sciences.

President Auerbach has appointed Mr. G. C. Tootill, of the Royal Aircraft Establishment, as Chairman of the IFIPS Committee on Standardisation of Terminology and Symbols. Mr. Tootill will be assisted by a committee with members from each national technical society active in the information processing sciences.

IFIP CONGRESS 62

An international conference, to be known as IFIP Congress 62, will be held in Munich, Germany, from August 27 to September 1, 1962. The Congress offers computer scientists and other specialists in the information processing sciences an opportunity for international exchange of ideas and technical knowledge. Plans for the Congress were ratified by the Council of the International Federation of Information Processing Societies at a meeting in Darmstadt, Germany, in February.

President Auerbach states that the IFIP Congress 62 will continue the activities of the International Conference on Information Processing, sponsored by UNESCO in Paris, June 1959. The forthcoming IFIP Congress in Munich will hold several days of technical symposia on information processing and information technology. A global exhibition of computers and other information processing equipment will be held in the Exhibition Park Theresienhoehe, Munich, at the same time as the Congress.

The following list of officers and chairman have been appointed by President Auerbach to organise the plans for the forthcoming Congress:

Congress 62 General Chairman:

Prof. Dr. Alwin Walther
Technische Hochschule
(16) Darmstadt, Germany

Congress 62 Vice General Chairman:

Dr. Hans J. Piloty
Technische Hochschule
Munich, Germany

Both represent DARA (Deutsche Arbeitsgemeinschaft für Rechen-Anlagen), the German national computer technical society and host of the Congress.

Arrangements Committee:

Chairman Prof. Dr. R. Sauer
Technische Hochschule
Munich, Germany

Vice-Chairman Mr. Albrecht Gunter
Siemens-Schuckert
Munich, Germany

This Committee will be responsible for the organisation of all aspects of the Congress in the city of Munich, except for Exhibits.

Exhibition Committee:

Chairman Dr. Heinz Billing
Max-Planck-Institut für Physik und Astrophysik, Munich, Germany

This Committee is responsible for organising the exhibition and plant tours. Consisting of representatives of the German computer manufacturers and also manufacturers from the other participating countries, it will direct the operations at the Exhibition Park Theresienhoehe in Munich.

Public Relations Committee:

Chairman Prof. Dr. Joseph Heinhold
Institut für Angewandte Mathematik
Technische Hochschule
Munich, Germany

Program Committee:

Chairman Dr. Niels Ivar Bech
Regencentralen, Copenhagen, Denmark

This Committee consists of the representatives to the IFIPS Council from the member technical societies, except for Dr. E. L. Harder, of the United States, who will serve in place of Mr. Auerbach, and Prof. Dr. F. L. Bauer, of Germany, who will serve in place of Prof. Dr. Walther. Both Mr. Auerbach and Dr. Walther are ex-officio members of this committee.

Publications Committee:

Chairman Dr. Maurice V. Wilkes
Cambridge University, England

Editor of the Congress Proceedings

Miss C. M. Popplewell

Editorial

PUNCHED CARD DATA PREPARATION

Management is quite capable of authorising the expenditure of a large sum on the purchase of a computer and expressing strong views on the required reliability factor of the machine, but simultaneously ignoring the problem of ensuring that accurate raw data is fed into it. Such a problem, involving considerable detailed study, is, of course, dealt with at the lower echelons of management, but there is considerable room for the opinion that in many places it does not receive the proper attention it deserves and that management would do well to pause and consider the effects of erroneous data fed into the system, particularly the cost of detecting it.

It was with this thought in mind that the Input/Output Study Group of the Society prepared a questionnaire in an attempt to apply a quantitative measure to this factor. This questionnaire was circulated privately in the autumn of 1960 and the results analysed early in 1961. These results were briefly referred to in the September 1961 issue of *The Computer Bulletin*, p. 70.

It was recognised that the 1960 questionnaire was not completely unequivocal in itself and in some areas the replies given were due to the manner in which the questions were phrased, a fault not uncommon in these days of official form filling. Nevertheless, apart from this it was clear that on error rates in particular, both before and after the verification processes, the reported results contained variations too wide to be due to any factors capable of explanation, other than lack of information on the true state of affairs. With only 60 replies out of 160 users circulated, the sample was probably too small for the determination of reliable average error rates, even if results had appeared to fall within a normal distribution. But so many replies fell in the extreme areas, both good and bad, it was difficult to explain them away. Three explanations were possible:

(1) That the 60 companies who replied from the randomly chosen sample of 160 turned out to be from the extremes of the population distribution: this is so improbable, as to be virtually a negligible possibility.

(2) That the distribution of the full user population does indeed follow the U shape of the sample. This conclusion seems too radical to be drawn from such a small sample, especially where the results supplied conflicted with the experience of members of the Study Group.

(3) That because of poor drafting of the questionnaire, or misunderstanding by the recipients, or by reason of other difficulties of communication, the answers given were to a greater or less degree inaccurate.

The Study Group came to the third conclusion. It was then decided to draft a further questionnaire, attempting to collect a greater number of replies by means of contact through *The Computer Bulletin*, but at the same time, by means of this editorial, to bring the attention of users to the need for the most careful collection of data. We may be sure that if several thousands of pounds were spent on this survey, with full-time investigators visiting installations, we could obtain fairly accurate results. Since this is not possible, it is necessary to rely upon the goodwill and co-operation of users who are in some way associated with, or at least interested in the activities of this Society. It is certain that if we obtain a good response with a high level of accuracy, the published results will be a good criterion on which to judge one's own individual installation.

In conclusion, attention is drawn to the attempt to relate the type of job to the error rate. It is likely that a difficult card form, with an original document not designed for use with punching (or even a well-designed document indifferently completed) will produce a higher error rate than average. If information is available as to the average error rate, as well as the particular error rate on the job selected for answering the questionnaire, both rates should be given in the answers to questions 14 and 16.

In the event of it being difficult to reply to some of the questions owing to the lack of records, it would still be useful to have the questionnaire returned with as much information as possible.

Completed questionnaires should be returned to the Society offices and all replies will be treated confidentially; only totals will be published.

* * *

SERVICE BUREAUX

Further details will be published in Bulletin 6/1.

Copy should reach the Editor by 16 *April* 1962.

COMPUTER COMMENT

Australian activities

The Australian National Committee on Computation and Automatic Control announces that it will hold its second Conference from 24 to 28 February, 1963, at the University of Melbourne.

Papers, which will cover both commercial and scientific aspects of the use of electronic computers and automatic control devices, will be preprinted and distributed to registrants before the Conference. All papers to be presented will be by specific invitation.

The Chairman of the Organising Committee is Mr. Brian Stonier of *Messrs. Kent Brierley and Fisher*, Chartered Accountants, 515 Collins Street, Melbourne. All enquiries concerning the Conference should be directed to the Hon. Secretary of the Organising Committee, Mr. L. J. Cohn, Actuary, *National Mutual Life Assoc. of A/sia, Ltd.*, 395 Collins Street, Melbourne.

Italy and Argentina Admitted to IFIP

Two more nations, Italy and Argentina, have been formally admitted to the International Federation for Information Processing, raising the total number of member countries in the Federation to nineteen. Their membership was ratified at a meeting during December of the IFIP Council in Copenhagen, Denmark.

AUERBACH Reporting Service

An information service to provide standardised data on the hardware and software of electronic data processing systems is scheduled for initial publication on 15 March. *Standard EDP Reports* will be a derived data service for electronic data processing users, similar to the looseleaf information services that have become reference media of current knowledge in law, in accountancy, and in engineering. The service, under the imprint AUERBACH/BNA will be prepared and edited by AUERBACH Corporation, of Philadelphia, and distributed by The Bureau of National Affairs, Inc., of Washington, D.C.

The new service claims to be unprecedented in the scope and depth of its coverage in the electronic data processing field. It is designed to help users of computers select equipment and software and to keep abreast of the state of the art and to provide manufacturers and sellers of equipment and consultants in the field, as well as users, with objective measurements of capacity, performance, and other specifications of all United States commercially available computer systems, peripheral equipment, and software. We hope that British manufacturers will also provide the publishers with data for abstracting.

De La Rue Bull

Mr. A. W. Myers has been appointed General Sales Manager of De La Rue Bull Machines Limited.

Royal Naval College

The Royal Naval College at Greenwich have announced the installation on 10 January of an IBM 1620 scientific computer in the Department of Nuclear Science and Technology. The computer will be used in post-graduate training courses for serving officers in connection with the nuclear propulsion of naval ships.

Studies will include neutron attenuation, reactor kinetics, reactor core and shield design, experimental analysis of sub-critical cores, guided and ballistic missiles and ship structure and design. Work will be linked with the Jason reactor to be installed with the College.

Other educational establishments which have installed IBM 1620 computers in the past year include Loughborough College of Technology, installed in April 1961, and the Cambridge University Department of Chemical Engineering, whose machine was installed in October 1961.

The Loughborough 1620 is used for final year and post-graduate courses in numerical analysis and the use of computers in instrumentation for process control. Work at Cambridge covers the study of the kinetics of reaction, heat and mass transfer, gas absorption and fluid flow; considerable emphasis is placed on persuading research students to use the computer for their projects.

Further installations during 1962 will include those at Swansea and Aberystwyth Colleges of the University of Wales, where "1620" computers will be used by the Department of Statistics, Applied Mathematics, Electronic Engineering, Chemistry, Physics, Agricultural Botany, Applied Psychology and Linguistics Research.

"Productivity"

Pergamon Press announce a new journal which will deal specifically with industrial and business management techniques. It has an essentially practical approach and covers such important subjects as materials handling, operational research, human relations, work study, budgetary control and cost accounting, etc.

Papers included in the January issue were

B. A. SKINNER:	Business Games—An aid to Management Training.
PHILIP DOULTON:	Recent Developments in the Lift Truck Field.
DOUGLAS R. WOODLEY:	A Revolution in Mechanical Handling.
I. J. D'AGATI:	Ship Loading and Unloading without Port or Dock Facilities.
R. BRAITHWAITE:	New Wages and Salaries Methods.
J. L. HAMPSHIRE:	Organisation and Method in Local Government.

Mr. Dudley Hooper is a member of the Editorial Board. Enquiries should be addressed to the Publishers, Headington Hill Hall, Oxford.

IBM Demonstrates New Voice-Recognition Equipment

An experimental machine which will do arithmetic on voice command was demonstrated on 15 November, 1961, by *IBM*. It is to be used to study the technical feasibility of automatic processing of spoken information.

Named "Shoebox" the new device can recognise 16 spoken words, including 10 digits and the instructions "plus", "minus" and "total", the words being converted to electrical impulses and classified according to various types of sound. The measuring circuit distinguishes between voice or larynx sounds and unvoiced or frictional sounds formed by lips, teeth and tongue. Words are registered in three parts, the first and last parts being unvoiced and the middle part voiced.

For example, the "s" in "six" precedes the vowel and is classified as an early strong frictional syllable. The sound energises the corresponding relay in the machine, and stores this information. Next, the vowel energises the relay for the sound "ih." Finally, the proper frictional-late relay is energised for the final sibilence of "six." The interconnected storage relays then energise the "six" key on the adding machine.

Shoebox operates on a principle which allows considerable tolerance to intonation and it will respond to a wide variety of voices, and to regional accents, presumably UK and USA accents.

Automatic Voice Replies

A new and economical computer inquiry voice-reply device named Unicall has been introduced by the Remington Rand Univac Division of the *Sperry Rand Corporation*.

Unicall is a by-product of the Airline Interline Development System, also originated by Remington Rand Univac. Adoption of this system could eliminate many of the difficulties and delays which now plague interline reservations or the sale of space between airlines. For example, only a few seconds will be needed for an agent equipped with a Unicall set to make and confirm reservations on a flight originating in a city hundreds of miles away on a *completely different airline*.

The new device enables transmission of inquiries to a Univac Real-Time Computing System from a remote location and—for the first time in the history of data communications—reception of stored computer-generated voice replies to the questions.

Complete messages (up to 40 alpha-numeric digits) can be transmitted from a Unicall set over conventional long-distance telephone lines to a computer from any point in the United States in approximately two seconds. Voice reply transmission (from the magnetic drums at the computer site) begins within a half-second of receipt of Unicall query.

The Unicall set is easy to install and economical to operate. Connection of a Unicall and Telephone Company Subset can be made to a conventional telephone line in less than fifteen minutes. The Unicall set itself is a low-power unit (during operation consumes 100 watts) and its small size (18 × 12 × 9 inches) facilitates use on a desk or counter.

Messages up to 40 alpha-numeric characters long can be sent in a single transmission. If a message exceeds this limit, a "more follows" key is depressed and the balance is sent to the computer on subsequent transmissions. Three identification characters precede each message block.

Unicall is expected to simplify and accelerate updating and reporting of changes in inventory, production, distribution and sales in many businesses and industries. The dissemination of all other vital business information will also be easier, faster and more economical than was ever possible before.

Hundreds of Unicall devices, installed thousands of miles apart, may simultaneously secure up-to-the-second verbal replies from a Univac Real-Time Computing System. Answers to pertinent questions which can be posed by the Unicall sets are stored on a magnetic drum at the computer side. After a Unicall message has been processed, the computer selects the appropriate reply from the drum and sends it back over the telephone lines to the Unicall set location. Less than five seconds will be required for this whole transaction.

Forty sliding levers on the face of the Unicall set can be positioned to correspond to individual letters or numerals in a specific message or query. This lever-setting operation is simplified by a format guide mounted at the top of the panel. A message display window enables the operator to corroborate his selection of numerals and letters before the message is transmitted. This feature is made possible by a digit display wheel which is geared to each positioning lever.

After the appropriate lever selections have been made, the operator is ready to send his message to the computer. This is done by dialling the computer on the telephone adjacent to his Unicall device. When the connection has been made with the computer, an acknowledgement signal is fed back into the Unicall set. Receipt of this signal trips a scanning mechanism and the message itself is transmitted at the rate of 20 characters per second over the telephone network.

Responses to queries from Unicall sets are made in seconds by the Univac Real-Time Computing System. The transfer of information from the Unicall set to the computer can be completed in two seconds. Then the voice reply begins immediately and takes from 3 to 5 seconds to transmit. A few of the checks which the computer makes before answering each message are:

(1) Determining if forty-four valid characters have been received from the Unicall set: i.e. 3 identification digits, 40 message digits, and 1 "end-of-message" or "more follows" digit.

(2) Making sure that the message itself is complete and complies with the required format associated with the particular type of transaction.

(3) Establishing whether additional messages relating to the ones received are or are not forthcoming.

(4) Corroborating that the message is not a duplication of a previous transaction.

When these message validity checks are completed, the computer selects and transmits the appropriate voice reply to the telephone connected with the Unicall set. As soon as the pre-recorded answer has been transmitted, another signal is generated which disconnects the Unicall set from the line and makes the line available to other users.

In addition to the Airline Interline Development System, applications are also being developed for: hotels, motor car rental agencies, stock brokerage houses, credit reference organisations, department stores and aircraft manufacturers.

International Programming Languages

The Internation Organisation for Standardisation is starting work on the standardisation of programming languages. As a first stage it is collecting data. British contributions are being co-ordinated by Mr. R. Goodman, *Brighton Technical College*, at the request of the *British Standards Institution*. Information would be welcomed on any "machine-independent" language (i.e. one which could be implemented for more than one type of machine without substantial loss of efficiency). Information should include the NAME of the language, a reference to a programming MANUAL, some details of the TRANSLATOR including origin, machine and configuration, approximate number of instructions, whether translation is direct to machine code or to some intermediate code, whether translation must be followed immediately by execution, class of APPLICATION and any helpful NOTES.

New Development Laboratories

The Laboratories and offices now being constructed at Hursley, south of Winchester, are the first stage of a building programme by *IBM World Trade Laboratories (Great Britain) Limited* to provide 55,000 sq. ft. of space for product development and capable of being extended to 96,000 sq. ft.

The buildings are set in a fine woodland part of Hampshire with magnificent views to the south and are related to Hursley House—a well-preserved country mansion already occupied by IBM. It is interesting to note that the estate land was at one time in the possession of Oliver Cromwell's son Richard and great care has been taken to preserve the very fine trees around the old walled garden near the house where the buildings are being erected. Landscaping will ensure a harmonious relationship between the new project and the existing property.

Making Computers Work Faster

Metallic spiderwebs etched on paper-thin sheets of glass are expected to make electronic computers work 50 times faster than they do now.

Developed by Lockheed engineers, the new process, nearing the end of a long research and development stage, aims at replacing as many as 4,000 hand-wired electronic parts with one machine-made etching. This will greatly increase the current speed of computer working. Other benefits include reliability and reduced cost.

The logic and memory systems of present-day computers are ferrite cores, woven together into complex circuitry with incredibly fine wire. With the new process, exotic alloys will be electroplated in spiderweb designs on to a thin sheet of glass. Then an etching process will clear the plate of all but the electronic circuit, some 4,000 metallic dots permanently fused to a hairline conductive grid.

New Deputy-Directors for ICT

The appointment of six new deputy-directors became effective following the annual general meeting of *International Computers and Tabulators Ltd.*, on 1 February. The deputy-directors are: Mr. H. R. Prytz, Mr. W. E. Johnson, A.M.I.Mech.E., Mr. K. B. Elbourne, Mr. M. McCrea, Mr. A. L. C. Humphreys, and Mr. E. C. H. Organ, O.B.E. With one exception, they are members of the Company's majority club which signifies the completion of 21 years' service. These appointments are directly related to the Company's expansion in the fast-growing electronics industry which has increased the responsibilities of higher management.

Brazilian Association Formed

We received at the end of January 1962, news from Mr. Fernando Rodriguez, a member of the BCS living in Rio de Janeiro, of the formation of the *Associação Brasileira de Computadores Electrônicos*.

The first Council of ABRACE includes nine individual members and ten representatives of manufacturers, etc., namely: *IBM, Burroughs, Candace, GE, RCA, National, Cia Sid Nac., Remington, Puc, and Bull.*

It is intended to hold regular meetings and the constitution provides for representation in due course on the governing body of delegates from seven regions, centred respectively on Brasília, Rio de Janeiro, São Paulo, Pôrto Alegre, Belo Horizonte, Salvador and Recife. Subscription for the first year (July 1961 to June 1962) would appear to be Cr$500.00 for individuals.

The provisional administrative office is located at ABRACE, a/c Cezar Cantanhede, Av. Graça Aranha, 174–gr. 1311, Rio de Janeiro. A duplicated quarterly bulletin, of local interest, has been published in the Portuguese language entitled *Bulletin da Abrace*. Our correspondent expects that Brazil will have 30 to 40 computers within two years.

Far-Fetched Computations

It is not generally realised in what unlikely subjects computers are nowadays used. The following list of applications and the subjects to which they relate sheds new light on this matter.

Planting an instruction	*Horticulture*
Control of figures	*Haute Couture*
Serial representation	*Television*
Horner's method	*Dietetics*
End-around carry	*Materials Handling*

In addition, applications to *Shopping* are represented by Cereal arithmetic, and Plaice value.

The obvious authorities are:

The Differential Analyser (textbook on the mechanical computer), by J. Crank (Longmans, Green & Co., 1947).

The Theory and Application of DC Restoring Circuits, by D. A. Levell (*Electronic Engineering*, XXIII, p. 182).

W. C. Gorgas . . . one of the world's greatest sanitarians . . ." (*Nature*, **174**, p. 633).

"*The authors wish to express their thanks to Mr. R. W. Flux, Manager of the Transformer Department, . . .*" (*Proc. I.E.E.*, **103B**, Suppl. 1, p. 58).

AUTOCODES FOR MATHEMATICAL AND STATISTICAL WORK

by H. W. Gearing

An address given at the inaugural meeting of the Edinburgh Branch on 13 *December* 1961.

Introduction

Electronic computers are able to work at high speeds only because they are programmed. Analysis of a problem, or a data processing procedure, and the programming of it for a computer in machine code, is a laborious task. In the early machines, users soon appreciated the advantage of having standard programs for assembly and program development, and a library of routines for regular calculations, complex number input and output, and for tracing the course of programs during program development, particularly when unexpected results were given when the program was tried on the machine.

Where jobs are to be done regularly, it is still most economical, in the long run, to program them in machine language using such library routines as may be available. But for jobs which have to be done only once, or where it is desirable to try-out part of the job first and then extend the application of the computer, simplified programming systems have been developed. By their means, the computer can be addressed in a form of English, or by direct use of mathematical symbols if these are available in the character set of the teleprinter-punch used for punching the program. These simplified programming systems to which I shall apply the term "Autocodes" (originally named by Brooker at Manchester), together with available libraries of programs, constitute a very significant extension of the machinery which is now available.

Besides saving the time spent on programming, these systems reduce the clerical errors of program writing by eliminating many tedious steps and this also reduces the time taken by program development. They also make it easier for the writer (or another person) to amend the program at a later date. In the earlier systems, the simplification entailed a varying loss of operating speed, varying between two and fifteen times as long to do a job on the machine. But a half hour of computer time after a few hours' programming in autocode is a more economic proposition for a one-off job, or trial of a routine job, than several weeks on programming, followed, after several trials, by a successful five-minute run on the computer.

The newer programming systems, which involve a preliminary operation to compile a machine code program, will suffer less loss of speed and will become the normal method of programming computers for calculations and data-processing work, where the operations are not sufficiently standard to justify the writing of specific or general programs in machine language.

Work at Rothamsted

In his valedictory Presidential address to The British Computer Society in London on 26 September 1961, Dr. Frank Yates reviewed the contribution which computers have made and are making in research statistics. It is on the solution of problems involving heavy numerical computation, in pure research, and in engineering design that, in his view, computers have achieved their most striking successes: Dr. Yates went on to point out that even in fields where computational tasks had previously been performed on desk calculators, computers could introduce three new features:

(*a*) Speed, e.g. where further progress depends on knowing results to date.

(*b*) A more thorough job, with better editing of data and more accurate calculations.

(*c*) Relegation of computational methodology to the machine, so that people requiring to do calculations do not have to know the detail of the calculations involved.

His paper (Yates, 1962), published in the January issue of *The Computer Journal*, reviews experience at Rothamsted and the development there of general programs for statistical work and some autocodes at other centres.

If a general purpose program is available to include a mathematical procedure or the statistical method which one needs for a piece of analysis, then more people can use the computer. I have prepared a schedule of some of the schemes that are now available, or may be expected to be available early in 1962. Those who have access to a computer may find this of interest to follow up whichever line of development is applicable.

Applications in Metal Box Company

In a paper published in *The Computer Journal* for April 1961 (Gearing 1961) I referred to the use which we, in The Metal Box Company Limited, had made of Pegasus autocode. I reviewed, in some detail, two programs. One of these was an analysis of a market survey for household trays in which interviews were conducted with some 1,100 households, covering 17 general questions and 10 observations of each tray found at the house: these questionnaires were analysed and 17 tables for the internal report were

printed direct from the computer output tape. The other program related to part of our work on experimental sales forecasting and is now available in the Pegasus/Sirius interchange scheme (Ferranti, 1960).

Our first computer application to quality control was in 1958–59 when we undertook an analysis of variance in connection with a productive operation being carried out by a group of machines in the chain between the sheet of tinplate and the finished open top can. Three factors were involved. The autocode program for Pegasus was thought to be rather slow and a full machine code program was written by Mr. D. Bulcock and is now available in the Pegasus interchange scheme. There are other analyses of variance programs available, notably one by BISRA (Carter and Taylor, 1960) which caters for up to seven factors, but if there are more than seven levels and only three factors involved, our program permits all the levels of data to be used.

Nowadays, we would not attempt to write a full machine code program unless the job was going to be frequently done and would require considerable machine time. In the group of machines which we are using, a compiler-program has become available which automatically translates the Pegasus autocode program into Sirius machine orders (Ferranti, 1959 and 1961).

In 1960 we were asked to assist in the analysis of data on the variability of some raw material which had been collected from sampled consignments over two years. Several different characteristics of the material had been measured. An autocode program was written to analyse each characteristic separately, printing sample means, ranges, standard deviations, and compiling frequency distributions of means and standard deviations. A hierarchic analysis of variance was also given at the end of each characteristic. We were asked to undertake this work on 29 March and the calculations were substantially completed on 12 April. Further calculations and a correlation between two characteristics were made on 3 June and 5 October 1960.

Here I would like to stress that although the program was written in autocode, which is normally advocated for one-off jobs, the program is a general one. The progress of the calculations is controlled by ten parameters and the print routine by seven more. Thus one program served for the analysis of all the different characteristics, including some that involved preliminary arithmetic on pairs of observations. The correlation program was written separately but took only two hours to write, using pairs of existing data tapes fed in on the two tape readers simultaneously.

Training in Programming

In May 1961 we held a four-day course at Head Office which was attended by 23 statisticians and mathematicians from Quality Control, Research and other divisions. Some of these were senior men who came to get a quick appreciation of what a computer might do, but others intend to use a computer and, to date, five people have written programs in autocode for particular problems. The programs fully developed, now available for Metal Box quality control and similar work, are as follows:

(1) Raw Material Analysis: eight different attributes: means, s.d., histograms, correlation, hierarchical analysis of variance (P. A. Clifford and H. W. Gearing).

(2) Correlation and Linear Regression of two Variables—Individual observations and group means (Miss P. Slight).

(3) Percentage Overlap tables for reference when testing double seams of open top cans (Miss B. Hebard and H. W. Gearing).

(4) Locus of three points on a new mechanism being developed by our Engineering Division: this program produced tables of the three loci, acceleration at each point and pressures (jerk) on each component (Dr. J. Franek and H. W. Gearing).

(5) Heat flow in a new process (Dr. Eva Huzan and E. Roberts).

(6) Reference tables of five functions for use with a new machine (B. Glyde and E. Roberts).

In each case, where development work of a confidential nature is involved, the circulation of theoretical details has been limited by the research officers taking full responsibility for the physical and mathematical formulae.

Considerable use has also been made of BISRA programs for Multiple Regression (Mrs. S. A. Robinson) and Analysis of Variance (*op. cit.*), and the Ferranti program for Fourier Analysis for studying periodic data. We acknowledge the help of those who have allowed us to use their computers for this work, namely BISRA, Ferranti Limited, Northampton College (London), and Messrs. Babcock & Wilcox Ltd.

Other Systems

I have dwelt at some length on the Ferranti systems, but I also append a reference list on systems available. A two-day conference of the Society is being held in London during the Easter vacation at NCAT, when available autocodes will be discussed. This will be of interest to those who wish to compare different systems.

Reference should also be made to the publications of the Automatic Programming Information Centre run by Mr. R. Goodman at Brighton College of Technology in Sussex. Society members in London and south-east England co-operate in this work.

Scientific Autocodes

The list appended covers a wide range of programs, compilers, autocodes. Among the autocodes which can be taught in a few days and which are already fully operational are:

Mercury autocode.
Pegasus/Sirius autocode.
Ferranti Matrix Interpretive Scheme.
Deuce Alphacode.
IBM Fortran.
Edsac 2 Autocode.
Stantec Zebra Simple Code.
Elliott 803 autocode.
Elliott and other systems based on ALGOL.

They use different techniques, for example:

(1) Stantec Zebra Simple Code Programming Manual (1960).

The Zebra computer has a machine code which seems to be oriented to the internal functions of the machine as seen by the engineer: it is, therefore, a difficult machine to program in normal code. The normal code is, however, very flexible and skilled programmers experienced with this machine can

attain high speeds. The teleprinter uses CCIT punched-tape code.

In the *Simple Code* the arithmetic functions are replaced by alphabetical characters. One is encouraged to look at the machine as a series of registers and scaling is covered automatically by arithmetic in floating point. Over thirty subroutines can be called up automatically, for example Z10 will cause the contents of the accumulator to be replaced by the logarithm (base 10) of the number previously in the accumulator.

(2) The Pegasus Autocode (also available for Sirius).

Ferranti computers use teleprinters which include a limited number of mathematical symbols in the character set. Hence the Pegasus Autocode comes easily to mathematicians: again one looks at the machine as a number of registers, some holding integers with exact counting and others holding floating-point numbers accurate to seven or eight significant decimal digits. This autocode can also be used on Sirius or Mercury; on Sirius, a machine code program tape may quickly be compiled for future use.

(3) The Elliott 803 Autocode.

This autocode handles either integers or mixed numbers in floating-point form. The autocode program is first translated by the computer and a special binary code program tape is punched. Parameters at the end of this indicate the storage space required by the translated program.

The translated program tape is then fed into the tape reader, followed by the functions tape. The data tape is then read in.

Facilities exist for allocating three new functions to cover special work: mnemonic instructions, e.g. A = Lim B are specified and machine orders written by the programmer to cover the subroutines involved. These are then put into a compatible form with the rest of the autocode library by the computer, for use on the particular job.

(4) With the General Purpose Programs and Programs available in interchange schemes, the user merely has to read the specification carefully, assemble certain control parameters and data into an agreed format and present that for punching, to get useful results.

Commercial Autocodes

Those concerned with Commercial Data Processing should have a look at:

ICT Rapidwrite—Cobol.
Ferranti Nebula.
$\left.\begin{array}{l}\text{Cleo}\\\text{Gipsy}\end{array}\right\}$ when available.

These may take a couple of weeks to study, because, speaking from experience with Nebula, there are not only procedure descriptions but also file outlines and specifications of format of data and results when dealing with computers having considerable ancillary equipment. The Scientific Autocodes are usually concerned with one medium of input/output only, punched tape or punched-cards.

Programming a data processing operation in a Commercial Autocode like Nebula becomes a full-time job; but it is easier to train staff in Nebula than a machine code and the autocode compiler will (we hope) take care of housekeeping routines when opening and closing files. We are using young men and women of O level mathematics, who have had experience of controlling our punched card routines, for this work.

Scope for Further Study

When one has committed oneself to use a particular system, one gets down to studying it and one has little time to claim any general expertise. One or more articles could be written on each system and in the space available I cannot attempt a general review, even if I were qualified to do so. I hope, however, that my references to our own experience in the Company may stimulate members of the Society to bring more people into closer touch with computers, to let those who understand a job, program it for themselves. This gives great satisfaction and relieves the specialist programmers for work on the installation of major jobs.

Learning to program a computer in autocode is now as easy as learning to drive a car and the roads are by no means as crowded.

* * *

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GEARING, H. W. (1961). "The Use of Pegasus Autocode in some Experimental Business Applications of Computers," *The Computer Journal*, April 1961, Vol. 4, p. 30.

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Appendix

Literature and References to Simplified Programming Schemes for Computers, Available or Projected—November 1961

The English Electric Company Ltd.

(1) GIP (General Interpretative Program)—easy system for matrix work (for DEUCE).
(2) Alphacode (for DEUCE)—Notes on Programming Deuce and Simple Alphacode Programming.*
(3) Multiple Regression Program (in GIP).

Elliott Brothers (London) Ltd.

(1) 803 Autocode Specification, Mark II (July 1960).*
(2) The Elliott Algol Programming System (August 1961).*

National Cash Register Company Ltd.

(1) 315 NEAT COBOL (NCR, Dayton, Ohio, 1961).
(2) 803 Autocode, Mark II (803.A2).*

Ferranti Ltd.

(1) Mercury Autocode Manual (2nd Edition)—List CS.242A. June 1961.*
(2) The Pegasus Autocode—List CS.217A. April 1959.*
(3) Assembly, Interpretive and Conversion Programs for Pegasus and Operational Experience with the Pegasus Autocode, by Felton and Payne. Reprinted from *Annual Review in Automatic Programming*, Vol. 1.*
(4) Ferranti Matrix Interpretive Scheme (1956).
(5) Extensive Library of Subroutines for Pegasus.
(6) Interchange Scheme between Pegasus Users.
(7) Nebula (Orion)—New Electronic Business Language.

EMI Electronics Ltd. (Emidec).

(1) GIPSY—(General Interpretive Programming System) Under development for Emidec 2400.
(2) LISP System for Emidec 2400. Experimental work in hand.
(3) ALGOL Compiler being developed for Emidec 2400.

ICT

(1) Rapidwrite Programming Manual. A simplification of Cobol for use with ICT 1301 Data Processing System.*
(2) ICT Cobol.
(3) MAC—Interpretation Scheme, Manchester Autocode to 1301.
(4) Multiple Regression Analysis—Program.
(5) Standard Statistical Autocode.
Under development October 1961.

IBM United Kingdom Ltd.

(1) FORTRAN for various Machines (1401, 1620, 7030, 7070/4, 7090, 650).
(2) Extensive Library of Symbolic Programming Systems, Statistical Programs and Subroutines.
(3) Extensive Compiler and Interpretive Routines.
(4) ALGOL Compilers.

Leo Computers Ltd.

(1) CLEO Programming System (Leo III) under development: Programming Manual expected early 1962.
(2) Library Programs available on Leo II include:
 (*a*) Formation of concomitance matrices from answers to questionnaires.
 (*b*) Conversion of concomitance matrices to correlation coefficients.
 (*c*) Simple multiple regression of form $X_1 = a + b_2x_2 + b_3x_3$.
 (*d*) Analysis of $k \times k$ balanced lattices from replicated experiments.

University Mathematical Laboratory, Cambridge

(1) R. K. Livesley. A Beginner's Guide to Edsac 2 Autocode (August 1961).*
(2) D. F. Hartley. Edsac 2 Autocode Manual (September 1961).*

Standard Telephones and Cables Ltd.

(1) Stantec Zebra Simple Code Programming Manual (1960).*
(2) The Simple Code for Zebra (W. L. van der Poel). (August 1959; paper in *P.T.T.–Bedrijf Deel*, ix, No. 2).*
(3) SEAL (Standard Electronic Accounting Language). *See* Annual Review in Automatic Programming.
(4) 40 Statistical Programs are available in Zebra Program Library. List.*

CEIR (UK) Ltd.

(1) L.P.90 Linear Programming System. The latest version of CEIR's linear program for the IBM 7090, handling over 1,000 restraint equations (rows) with a very large number of variables. Several special features are included such as various routines for post-optimal analysis.
(2) Opal.
(3) Statistical Programs available include:
 (*a*) Multiple Regression Analysis. A correlation analysis that provides multiple and partial correlation coefficients, standard errors, t and F values and estimating equations for as many as 145 variables with over 30,000 observations. The program has numerous variations, including the ability to weight, skip and lag observations for autocorrelation purposes.
 (*b*) Time Series Analysis Program. CEIR's version of the US Bureau of the Census time series "decomposition" into seasonal, trend and irregular components, for application to a wide variety of economic data.

(c) Transportation Problem. The MIT program for least cost allocation of sources to destinations. This program can handle as many as the sum total of 6,000 sources and destinations.

(4) CEIR Coder. Business Language Scheme under development.

Honeywell Controls Ltd. (400 and 800 computers: not yet in use in the UK)

(1) FACT—Commercial Compiler (for 800) with extensive sorting facility. Manual DSI–27A dated 1960: Revision in progress, October 1961.*

(2) ALGEBRAIC COMPILER. Basically Fortran II with additions. Manual DSI–44 dated 1961.*

(3) ARGUS (mnemonic system for 800).

(4) EASY (mnemonic system for 400).

(5) Sorting on 400. Manual DSI–41A.*

De La Rue Bull Machines Ltd.

(1) SAP (Statistical Analysis Program). Brochure PAS published by Compagnie des Machines Bull, 94 Avenue Gambetta, Paris 20eme.*

(2) Library Routines for correlation, auto-correlation, chi-squared, etc.*

— Compagnie des Machines Bull general documentation on statistical programmes.

— Minutes of Meetings of "Association des Utilisateurs de Gamma ET," 12 Place des Etats-Unis, Paris.

— CNCE (Centre National de Calcul Electronique) documentation on statistical analysis (problems dealt with by Compagnie des Machines Bull Service Bureau in Paris).

Remington Rand Ltd.

(1) FIAT Floating Point Mathematical Interpretive Scheme.

(2) X–6 Assembly System. A programming aid for Magnetic Tape and Punched Card Systems (e.g. USS.80 available in 1962 in London and Manchester).

* * *

* Copy available in BCS Library at Leicester and IOS Library at London. Programming manuals and documentation are copyright of each manufacturer. Copies of some have been made available in the Library; all inquiries by intending users should be addressed to the manufacturer of the available machine and not to the BCS or the author.

New Physical Effect

The discovery of a new electrical characteristic in one of a group of metals called semi-metals is reported by *IBM*. The discovery, in bismuth, was made by Dr. Leo Esaki of the *IBM Thomas J. Watson Research Center* in New York. As a result, increased research activity in semi-metals is expected which may lead to the future development of speedier electronic devices.

Bismuth, antimony and arsenic are known semi-metals. These materials are solid conductors, whose characteristics class them between semi-conductors and metals. They are of special interest because electrons move in them in somewhat the same way that electrons move in the familiar radio tube. If a method can be found to control these electrons, a new class of high-speed amplifiers and switches may result. Scientists have only recently conjectured about the promise of semi-metals. Until now no one has experimentally used the right combination of material, electric field and magnetic field. The combination used by Dr. Esaki consisted of applying strong electric and magnetic fields, at right angles to each other, across a single-crystal of ultra-pure bismuth at temperatures close to absolute zero (—459° F). Under these conditions he found that the semi-metal did not follow a basic electrical law of conduction, Ohm's Law, but instead an abrupt change or "kink" appeared in its characteristic conduction as the fields reached a certain strength.

This kink had never before been observed—and its origin is still to be determined. Dr. Esaki and his associates believe the kink is caused by an interaction between tiny sound waves and electrons inside the semi-metal. Experiments are now in progress which should yield more exact information concerning this phenomenon.

A paper describing this new physical effect entitled, *New Phenomenon in Magnetoresistance of Bismuth at Low Temperature*, by Dr. Leo Esaki, appears in the 1 January 1962 issue of *Physical Review Letters*, a publication of the American Physical Society.

"Furthest-South" Computer in Britain

It is announced by *Elliott-Automation* that the Post Office has ordered a National-Elliott 803 Electronic Digital Computer for use at its satellite system radio station on the Lizard, Cornwall, in connection with transatlantic tests of communication satellites next year.

The Computer will be used to convert predicted orbital information derived from the U.S. Minitrack world-wide network of tracking stations into steering instructions on punched tape for controlling an 85 ft. diameter paraboloid steerable aerial at the Post Office radio station. At the appropriate time, the steering instructions on the punched tape will be fed into the electronic controlling equipment of the aerial which will then be pointed in the direction of the satellite as it appears above the horizon. Throughout the course of the satellite, as it rises to its zenith and falls towards the horizon, the aerial will continue to be pointed automatically at the satellite, with a precision of the order of one-tenth of a degree.

The application is one which demands a high degree of reliability in the computing equipment, involving as it does long periods of continuous operation. In a recent statement from *Elliott-Automation* it was stated that a National-Elliott 803 computer exported to the United States had completed over four thousand hours of continuous operation, demonstrating conclusively the outstanding reliability of this machine.

SYMPOSIUM ON ELECTRONIC AIDS TO BANKING

Reported by P. G. Barnes

Introduction

A two-day symposium under this title was organised by the Institution of Electrical Engineers and presented under the aegis of the British Conference on Automation and Computation in collaboration with the Electronic Sub-Committee of the London Clearing Banks. It took place on 17 and 18 January, 1962 at the Institute of Electrical Engineers. The Symposium was arranged to bring together representatives from the banks and electronic engineering firms to discuss problems of common interest.

Four sessions were presented, the first by the Banks to outline their user problems. At the three following sessions papers were read by engineers on the ways and means currently available to meet the Banks' needs in respect of character recognition, cheque sorting and data transmission equipment.

Sir Eric Carpenter, President of the Institute of Bankers, opened the proceedings. Banks, he maintained, were slowly but surely introducing electronic aids. The rate of progress and the present position in using electronic aids was then detailed by members of the Electronic Sub-Committee of the London Clearing Banks.

The problems of maintaining customers' current accounts in the face of a steady growth in the use of cheques by the public (at the rate of about 30 million extra cheques per year) were described. The first problem in maintaining a current account is common to all clearing banks: to sort and clear to individual banks the cheques which pass through the central clearing branches in London. In 1960 some 682 million cheques were cleared. A vital step in the solution of this problem was taken by the London Clearing Banks in December 1960 when they decided to adopt the American Bankers' Association stylised characters, known as E-13B, with characters printed on documents in magnetisable ink. In July 1961 the Committee fixed the details of the code line, which is the line on cheques on which, to given tolerances, the customer information and amount are written in magnetisable ink. The problems involved in putting one line of magnetisable ink on a specified area of paper are much larger than would appear at first sight. Mr. Temple, Secretary of the Electronic Sub-Committee, showed, by use of slides, twelve possible faults in the printing; the faults have such descriptions as "skew," "void," "alignment," "embossment," etc. Printing on the code line will probably be done in two stages. The first, by imprinting, will "personalise" the cheque and other documents to show the customer's name and account number, the latter in E-13B style characters. Encoding will apply to the "Amount" field and will, in general, be carried out as a by-product of an adding or listing operation.

The clearing of a cheque is, of course, only one stage in its journey from debtor to creditor. The debiting and crediting of a customer's account is a job for the individual bank, and each bank may well find its own solution, although, of course, cheques with E-13B style characters will be standard input to any system. The work flow into a bank from this source fluctuates widely day by day and a peak to mean value of 2 : 1 is common. The work must be carried out on a daily cycle and cannot be spread over the week or month. In making plans for automatic processing of cheques the banks must take note of the variable work load and consider other jobs, with less severe time restrictions on them, as base loads for any equipment. The cost of computers to undertake the volume of work, to say nothing of the staffing problems involved, leads to the idea of centralised systems. The banks, however, place great emphasis on the personal customer service and even the smallest bank around the corner is a vital link in the bank's personal contact system with its customers. Centralisation does not and cannot mean the end of small branches. Communication between branches and the centralised system is thus vital. Mr. J. Sauvage described some of the user problems in maintaining a communication system. He has experience of a data transmission system using a "copper loop" line, rented under Tariff H, operating at 75 bauds. The merits of error detection and error correction were discussed but it was felt by Mr. Sauvage that priority of research should be spent on providing better lines rather than on error correction equipment.

The banks thus presented their problems and their experiences. There were remarks, made in the friendliest manner, about the ability of the manufacturers to produce the necessary equipment when it was wanted and at a reasonable cost. The banks, so they said, were willing to pay their share of R & D in the overheads put on the selling price, but they did not see why they should directly finance research. The session ended with Mr. Letham outlining his data processing system at the Bank of Scotland. This grew from a paper tape transmission system over telex lines from an office 12 miles away, the tape being converted to cards which provided input to an IBM 420 accounting machine. The system was extended to cope with work from more offices and required two IBM 421 accounting machines. A comparatively low cost, slow system was thus built up and provided the experience necessary to install a faster, more expensive computer based system.

A 1401 computer has now been installed and is dealing with all the ledger work of twelve branches of the bank. It is felt that one 1401 will be able to cater for about 30 branches. The programming for the 1401 was carried out by the Bank's own staff and success is claimed in the use of aptitude tests to select likely programmers. A good bank examination result did not necessarily mean that a candidate was suitable for this special work.

The second and subsequent sessions were devoted to engineering problems. Mr. Cooper (*EMI*) outlined the difficulties associated with reading magnetic ink characters and discussed how some of these had been overcome during the development of FRED, which was an alternative character reading system to the E-13B. Mr. Vermeulen (*IBM, Holland*) described the IBM cheque reader/sorter and then Mr. G. Deadman (*Ferranti Ltd.*), in the absence of the author, Mr. G. Davis of *Ferranti Packard*, read a paper on the problems of high-speed sorting of magnetic ink characters. There are two main types of sorting, known as the "digital" and

"dictionary look up" systems. In the "digital system" the document is sorted one character at a time and in consequence as many passes as there are digits are required to sort the final numbers. Eleven or twelve pockets are used, ten for the digits and two for special symbols and rejects. The "dictionary look up" system uses the whole sorting number and compares this with a pre-stored reference or dictionary. The number of pockets is not limited and, in theory, all documents can be sorted in one pass. The dictionary system is best when the number of end points is high and there are a number of sorting digits. A memory to store the dictionary is clearly expensive and, being electronic, will usually be available for access in a much shorter time than the mechanical system serving the documents. Hence one dictionary can serve several mechanical document handling units. Dr. G. Monro (*Nation Document Corporation*) described one such dictionary look up unit. This was a magnetic drum with 64 active tracks for storage. The drum rotates at 1,800 r.p.m., which is more than sufficient to cope with a sorter reading at 1,200 documents a minute.

Mr. S. Dixon-Child (*NCR*) ended the session with a description of a sorting system to deal with a hypothetical bank with an average daily clearing of 650,000 items and a peak of one million; all sorting had to be carried out between 10 a.m. and 4 p.m. with a machine utilisation of 5 hours. The proposed equipment was three sorters operating at 1,600 intermixed, different sized cheques per minute coupled on-line to a computer—i.e. using the computer as a dictionary store, simultaneously preparing a magnetic tape of the entire code line from each cheque in random sequence on the first pass of the documents. On the second pass there would be a combination of on-line sorting and digital sorting on two additional "off-line" sorters. The third pass would be digital sorting on all five sorters. In effect, by using a computer coupled to the sorters, an electronic analysis of the information stored on the vouchers is made while they are being physically sorted. The time for this operation, using the five sorters and a 315 computer is claimed to be about 1 hr. 47 mins.

During discussion Mr. Smith (*GPO*) wondered if E-13B was not a case of the tail of the dog wagging the dog. Cheque sorting, he pointed out, was not the end of sorting problems. He felt no real progress would be made until we could automatically read characters typed by a ten-year-old typewriter with a worn-out ribbon!

The second day opened with a session on "Accounting Aspects and the Use of Computers." Mr. G. Deadman (*Ferranti Ltd.*) discussed the organisation of a bank computer centre. There are problems of when information should be fed to the centre, as data are being prepared throughout normal working hours. Should it be sent in at the end of the day, continuously, or in batches? It was suggested that data should arrive in batches and be processed on the computer as soon as possible after arrival. This allows errors to be detected and if possible corrected on the same day, but it demands a time-sharing computer for efficient working, and clearly the computer must have a base load on which to work in periods when there is no input from bank branches. Dr. Pinkerton (*Leo Computers Ltd.*) stated the case for internal checking of computers carrying out this work with particular reference to the LEO III system. With a time-sharing computer several programs may be run at once and errors can arise if one program, due to a programming error or corrupt data, interferes with another program. Additional digits are added to words stored in Leo and these insure that when a given program occupies the attention of the control the program does not refer to any storage area outside its own "reserved" area. However elaborate the hardware checking, Dr. Pinkerton strongly advocates program checks—especially on the validity of input data.

Mr. G. Miller (*NCR*) described the problems of encoding cheques. Ideally this should be done at the bank where the cheques are first presented, but this raises the problem of one bank marking a cheque belonging to another bank. The cheque must subsequently be read on equipment of perhaps another manufacturer. Many thousands of machines would be needed for this purpose, and such machines would of necessity have to add/list as well as encode. An American machine to this specification is soon to be demonstrated in this country. Delivery might be up to a year but the banks would like the equipment now for field trials. As one banker pointed out in discussion, every country using decimal currency can get the equipment. Why does it take so long after the initial machine has been announced to make a sterling version of it? The old problem, which comes first—the machine or the large orders which make economic production worth while?

There were two papers in the final session which discussed the economics of data transmission systems. One, by Mr. S. Koumal (*Marconi Ltd.*) was read in title only, and gives an interesting formula for calculating the cost of a transmission system. It is a formula for the mathematician and not the banker. Mr. Shore (*AT & E Co. Ltd.*) in reading the paper by himself and Mr. Wolff (*British Telecommunications Research Ltd.*) quoted the Bible as the authority for binary codes "Yea, Yea, Nay, Nay, anything but these is evil." He drew attention to the need to include labour and operator costs, with their overheads, in a data transmission system. Some systems require an operator full time, others only a small percentage of the time. This is a paper to be recommended for those interested in data transmission.

Throughout the Symposium it was stressed that there was only one way to really find out error rates—by the use of the actual line. Mr. F. Beckett (*Ericsson Telephones*) produced some figures from trials last summer over various routes to Edinburgh. The results, he claimed, indicated that an error correction code was useful in simple equipment with no automatic repeat facilities, giving considerably longer error-free periods than would otherwise have been possible.

Other forms of document transmission were discussed. Mr. J. Bell (*Muirhead & Co. Ltd.*) demonstrated facsimile transmission by which a statement, say, could be transmitted over normal telephone lines to a branch, giving the customer a permanent copy. Mr. Waters and Mr. Gamble (*Pye TV Ltd.*) discussed and illustrated the use of television in banking.

Both facsimile and TV transmission have customer appeal—the tired housewife out shopping can slip into the bank and in a private viewing room see her money on the "telly!" More serious though, with a central ledger system, is the problem of internal communication between the staff of the bank and in this field there appears scope for both facsimile reproduction giving a permanent record and TV with its transient picture.

This was the first time that the banks have got together in public with the engineers, although the Electronics Sub-Committee was formed some six years ago. I was impressed by the conviction of the bankers that what they were doing was right. Perhaps there was a feeling that things ought to move more quickly but that they were held back by the manufacturers—particularly by the manufacturers of document

handling equipment. Should not the computer manufacturers supply all the equipment and not just the central computer? The manufacturers, in their turn, could accuse the banks of moving slowly and not placing large enough orders. I went to the Symposium with a slight feeling of sympathy to the manufacturers. I came away with a similar degree of feeling towards the other side. As Sir Eric Carpenter said, banks are slowly but surely introducing electronic aids. The equipment they use and develop covers a wide field of automation—computers, data transmission, document handling. The accuracy and security problems in banking are severe enough to satisfy most other types of work. All in the field of automation will watch, and I am sure benefit from, the banks' progress.

The full proceedings are to be published at a later date and inquiries should be directed to the IEE.

COMPUTER SERVICE BUREAUX

At the time of going to press, information on a number of service bureaux had not yet arrived possibly due to postal delays. It is hoped to offer further details to readers in the next issue of the Bulletin.

CEIR (UK) Ltd.

84 *Kingsway, London, W.C.2*

In London CEIR has a staff of over one hundred people, a large proportion of whom are scientific and professional. Directors include:

A. S. Douglas, Director of Technical Services, Programming and Computers.
M. G. Kendall, Director of Scientific Services.
S. Kochanski, Director of Engineering Services.
G. Miles, Director of Data Processing.
E. M. L. Beale, Manager of Mathematical Statistics.

The Management is supported by a large team of mathematicians, programmers, engineers and data processing specialists. The CEIR London Centre has IBM 7090 and 1401 facilities.

CEIR can provide a complete range of facilities from advice and consultations on any problem where logical or mathematical analysis is applicable, through access to computers on a time rental basis, to the analysis and preparation of reports.

The following are currently available:

LP 90

The latest version of CEIR's linear program for the IBM 7090, handling over 1,000 restraint equations (rows) with a very large number of variables. Several special features are included such as various routines for post-optimal analysis, to allow for examination of alternative solutions. Prices vary with the size and complexity of the job, running upwards of a few hundred pounds.

Transportation Scheduling

A CEIR 7090 program for least cost allocation of sources to destinations. This program can handle up to the sum total of 6,000 sources and destinations. Again prices vary. Since the transportation model is a fairly simple variant of a linear program, prices are relatively somewhat lower than LP 90 and follow a similar sliding scale.

Routing Planning

A combinatorial analysis developed by CEIR's Winston Riley, to expedite the routing of travelling salesmen or fleets of buses or trucks. Each of these projects may be expected to have some unique features. Prices will be quoted for each job.

Time Series Analysis

CEIR's version of the US Bureau of the Census time series "decomposition" into seasonal, trend and irregular components for application to a wide variety of economic data. Prices begin at £60 for two series, £10 for each additional series up to 30, £5 each thereafter.

Management Strategy

CEIR's decision-making exercises and training programs are available to managements who require strategy problems for their own training programs, or who wish CEIR to function on a consultant basis in developing and presenting management courses. Prices for exercises alone are of the order of £15 per participant-day for groups of 25 or more. Special prices will be arranged for smaller groups, longer training sessions, or consultation and development of exercises as a part of training programs.

Multiple Regression

A correlation analysis that provides multiple and partial correlation coefficients, standard errors, t and F values and estimating equations for as many as 145 variables with over 30,000 observations. The program has numerous variations, including the ability to weight, skip and lag observations for auto-correlation purposes. No prices are prepared yet but they may be expected to be in the Time Series Analysis range.

CEIR is currently developing the following programs which should be written and debugged within two months:

1. *Critical Path Analysis.*—The elaboration of CEIR's PERT program to incorporate a cost function into the job priority network analysis for production control. No prices ready.
2. *Pipe Stress Analysis.*—Given the anchor points and pipe specifications, this program computes allowable thermal stress. No prices ready.

De La Rue Bull Machines Limited

114/118 *Southampton Row, London, W.C.*1

Service Bureau work has been undertaken since the end of 1959. A GAMMA 3 computer as well as a 300 Series punched card system is used for this purpose. In addition, later this year, a GAMMA 30 installation will increase the range of machines available to customers. Programming and the punching of customers' card files are, of course, included among the facilities offered.

The customer Service Bureau jobs are divided into two principal sections, namely Sales Analyses and Statistical Work.

* * *

Elliott Bros. (London) Ltd.

Borehamwood, Herts.

Equipment available (March 1962)

(1) Elliott 402F computer; 4,992 word drum store, automatic floating point paper tape reader, paper tape output.

(2) National-Elliott 405 computer; 512 word nickel line store, 16,384 word disc store, 4 magnetic film units (2 + 2 simultaneous), 2 paper tape readers, serial film output.

(3) National-Elliott 405 computer; 512 word nickel line store, 16,384 word disc store, 6 magnetic film units (4 + 2 simultaneous), 2 paper tape punches, serial film output, line film output.

(4) National-Elliott 803 computer; 8,192 word core store, 2 tape readers, 2 tape punches, automatic floating point unit, 5 magnetic film units (any 4 switched in at a time).

Off-line output is carried out on a large number of Creed Interpreters, Flexowriters and a Bull line-printer. Input at present is entirely paper tape. Later in the year a card reader is to be added to the 803 computer.

Organisation

The computers and printing equipment are operated by Machine Room staff who work on a regular two-shift basis.

Paper tape for input is punched and verified or edited in the Punch Room.

The Planning Department carry out system analysis and planning, programming and coding.

The Engineering Department is responsible for the maintenance and improvement of all equipment.

Applications

A large part of the 405 computer usage is for commercial applications in various Divisions of the *Elliott-Automation Group*. Some of the important jobs running or being implemented are: payroll, stock control, labour costing, production planning. Elliott Divisions also use the 402 and 803 for technical calculations.

Service work carried out for customers include statistical problems involving the digestion of very large amounts of data and a wide variety of scientific, engineering and other technical calculations. The smaller jobs are nearly all programmed for the 803, in the Elliott Autocode.

Two of the sets of generalised application programs currently being prepared are for critical path analysis (PERT) and market survey questionnaire analysis.

Service

All equipment is available for straight time hire by a user doing his own programming. The Computing Service Division staff are also available for programming or for carrying out an entire job including problem study, programming and testing, preparing input, operating, printing and checking. This can be done for one-off jobs or for regular runs requiring results at scheduled times.

"Business" data processing on a service basis is channelled through our associates, *National Cash Register Company*, Data Processing Centres.

Charges

Charges for programming punching or carrying out a complete job are subject to negotiation. The charges below are the basis for time hire:

405 computer	£40 per hour
402 computer	£20–£25 per hour
803 computer	£25–£30 per hour

* * *

EMI Ltd.

20 *Manchester Square, London, W.*1

At present one EMIDEC 1100 is installed and operational. Later this year a second, more powerful, EMIDEC 1100 will be installed at the same centre. This second computer will be faster by virtue of a new printer (the Analex 1,000 line/min.) and a new paper tape reader (the Elliott 1,000 character/sec.)—the existing machine being equipped with the Samastronic 300 lines/min. printer and Ferranti 300 ch./sec. paper tape reader.

As far as the facilities offered by the Bureau are concerned, *EMI* operate a flexible system whereby the customer, if he so desires, can undertake the programming and use the Bureau on a time rental basis (£35 per hour). On the other hand, *EMI* is prepared to write the programs for the customer, and run the whole job from beginning to end.

If, incidentally, the customer wishes to rent time on the computer only, then courses for customer programmers are run regularly by *EMI Electronics Limited* at Hayes, Middlesex.

Other facilities offered by the centre include data preparation (paper tape and card punching), a comprehensive range of punch card and paper tape equipment, together with a telecommunication link for speed of data transmission. The centre is staffed by specialists in all these fields.

* * *

Ferranti Ltd.

68/71 *Newman Street, London, W.*1.

Owing to Postal Delays, full details of the Ferranti Services have not been included in this issue.

Briefly, Ferranti have two PEGASUS Data Processing Systems and a SIRIUS in London, and access to other PEGASUS installations. They also use the PEGASUS at Hollinwood for Northern work.

Their work covers all types of computing. Market Research, Sales Analysis and critical path scheduling are specialities. Their turnover has always been substantial and has increased five-fold in the last three years. Charges vary from £60/hour to £20/hour depending on the machine used and circumstances.

GEC Ltd.

Erith, Kent

The Computer Unit at Erith is a service bureau for the Company, but spare time on the computers may be hired by other companies. Operating assistance and tape editing facilities are available, but not, normally, any programming assistance.

The two computers in operation are:

(i) Ferranti MERCURY with 3 magnetic drums. Paper-tape input/output only. A graphical display unit will be available in the near future.

(ii) Electronic Associates PACE 231R. Single console with 80 amplifiers.

* * *

Honeywell Controls Ltd.

The Electronic Data Processing Division of Honeywell Controls Limited are offering the services of a comprehensive and fully equipped Service Bureau in the City of London. This Service Bureau is situated at a Computer Centre in Moor House, one of the new office blocks forming part of the City's Barbican scheme. Preparatory work for customers is already being carried out and actual processing of customers' data commences in May of this year.

The City of London Computer Centre is equipped with a Honeywell 800 Electronic Data Processing System, using the Honeywell standard speed magnetic tape units of 96,000 decimal digits per second. It has facilities for processing data from both punched cards and paper tape; data transmission facilities will also be available.

Honeywell have available an extensive proven and operating group of automatic programming routines, an important factor in reducing the time and cost of preparing problems for processing on a computer. Honeywell compiling and assembly routines bring a new basis to the whole subject of Computer Service Work, simplifying the stage from job planning to final computer processing. In addition, the true Parallel Processing capabilities of the Honeywell 800, together with this large operational family of automatic programming routines, make it one of the most powerful machines currently available for service work.

The Honeywell 800 system is suitable for processing both commercial and scientific problems. It has the ability to operate in binary and decimal, floating or fixed point arithmetic. It has facilities for indexing, masking, indirect addressing, simultaneous reading, writing and processing, and bi-sequence selection of instructions.

Training facilities for customers' staff are available at the Computer Centre for organisations wishing to use the Honeywell 800 or work may be undertaken by Service Bureau programmers. Assistance and advice on any computing problems are always available.

* * *

IBM (UK) Ltd.

Given the premise that the job-cost of data processing descends steeply the more powerful the computer system used, it follows that the IBM 7090, the most powerful system in general use in the world would be the ideal machine for a wide range of scientific and commercial applications in this country. An essential condition, of course, is that the machine must be in operation for a high proportion of its time and this makes its installation by the small user impractical. It is to bridge this gap that the IBM Service Bureaux and Data Centre exist.

Time is taken on the machines in these installations by customers having widely differing problems. Some have no data processing equipment of their own, so that the whole of the work, from punching the cards to final reports is done for them. Others have small installations which are inadequate for sudden or seasonal peak loads, while still others have new equipment installed or on order and need to gain experience in programming and operation. In scientific work the problems are different again, and a common Service Bureau application is the calculation of great complexity which needs to be solved only once, but which is too large to be processed by conventional methods.

To customers in all these categories the IBM Service Bureaux and Data Centre bring the data processing experience of half a century, a range of powerful equipment, the skill of specialist personnel and a library of ready-written computer programs covering commercial and scientific applications.

The following table sets out the equipment available or to be installed in the separate IBM locations.

Data Centre, London.

- IBM 7090 Data Processing System.
- IBM 1401 Data Processing System.

Service Bureaux, London.

- IBM 650 Computer.
- IBM 604 Electronic Calculator.
- IBM 1401 Data Processing System. (To be installed in April 1962.)
- IBM 1620 Scientific Computer. (To be installed in June 1962.)

Service Bureau, Birmingham.

- IBM 1401 Data Processing System.

Service Bureau, Newcastle.

- IBM 1620 Scientific Computer. (To be installed next year.)

The capacity of the 7090 to perform almost a quarter million arithmetical operations per second enables it to condense into minutes, scientific calculations which otherwise

would require years of manual effort. Yet so versatile is it that it can equally be used for routine commercial and scientific work.

The 1401 is a smaller scale machine with high input and output speed card reading at 800 per minute, card punching at 250 per minute and printing at 600 lines per minute. At the Data Centre it is used on line with the 7090, or off line as a separate unit.

The 1620 is a desk sized machine specifically designed for use by scientists and engineers. Although small in size it has the speed and calculating capacity formerly associated only with much larger systems.

Since computer programming in the numerical form used by the machine is tedious, lengthy and prone to error, IBM has always placed great emphasis on programming systems, such as FORTRAN which allow the programmer to work in language familiar to him, and to use macro-instructions where one written statement generates a number of program steps.

FORTRAN is available at the Data Centre, as is also a large library of computer programs many of which can be used without modification, especially in scientific work. The SHARE library of 7090 programs contains almost 1,000 programs while programs for other machines also held by IBM bring the total to almost 2,000.

These are the tangible advantages of the Service Bureau approach to data processing, but there is another, less easy to measure. This is the opportunity it provides for the examination by highly skilled specialists of routines and procedures which serve their purpose but which can frequently be streamlined in the process of reducing them to computer terms.

* * *

ICT Ltd.

Wolverley House, 18 *Digbeth*, *Birmingham* 5

Of the 17 data processing bureaux maintained by ICT in the United Kingdom, the Midland bureau is one of the largest. Situated in the centre of Birmingham at Wolverley House, and taking up the whole third floor of a modern office block, the bureau has a staff of more than 70 people, and a wide range of data processing machines, including the most up-to-date electronic equipment.

The bureau is equipped with a range of 40- and 80-column punched card machines and a Type 1202 Electronic Computer. It serves the whole of ICT's Midland sales region. This includes Birmingham, South Staffordshire, Worcestershire, Shropshire, most of Warwickshire, Leicestershire, Northamptonshire and Rutland; also the west country—Cornwall, Devonshire, Somerset, Wiltshire, Gloucestershire, Herefordshire, and the whole of South Wales and Monmouthshire.

In any one year the bureau undertakes about 2,000 jobs for some 150 organisations, half of whom use the bureau service regularly at fixed intervals. Work for the others is done intermittently or "once-off." Many organisations, who are users of ICT equipment, are assisted by the bureau, by having work done in "peak" periods, or by the loan of bureau operators to work at customers' installations. Some 10,000 hours per year are worked by Midland bureau operators on this loan basis.

The computer is available to commercial, industrial and other organisations at a hire charge of £25 per hour, which includes the charge for a machine operator.

* * *

National Cash Register Co. Ltd.

The service centres are:

(*a*) NCR Financial Computing Centre, Moor House, London Wall, E.C.2. The Computing Centre Manager is Mr. C. T. Ross. Telephone: NATional 9238–39. The Computer in use at present is the National-Elliott 803 with a National 315 to be installed.

(*b*) NCR Commercial Computing Centre, 206–216 Marylebone Road, London, N.W.1. The Computing Centre Manager is Mr. G. D. Sobell. Telephone: PADdington 7070 Ext. 153.
The Computers being used are: two National-Elliott 405's, one National-Elliott 803, with a National 315 to be installed in the near future.

(*c*) NCR Scottish Computing Centre, Dundee. A National 315 will be installed in the near future.

Examples of work undertaken

Analysis of claims for shipping insurance fund for a shipping insurance firm, weekly payroll for an electricity board, evaluation of interviewer's daily log sheets and weekly panel figures for the Broadcasting Corporation, profit and loss accounts and balance sheets for contractors to the oil industry, share index calculations for *The Times* and two different weekly journals, stock control for a publishing house, statistical analyses for agricultural seed merchants, maintenance of register of unit holders for a unit trust and analysis of market research forms for a trade association.

In addition to the above type of work, insurance premium calculations are undertaken for a number of insurance companies and consulting actuaries.

* * *

Univac Computer Service Facilities

6 Tape USS 90 Systems are available for hire at *Remington Rand Limited*, Remington House, 61/65 Holborn Viaduct, London, E.C.1 and *Remington Rand Limited*, 21 Spring Gardens, Manchester 2.

Programming aids and a full library of routines are available to customers and programming services may be arranged at agreed charges. Charge for machine time varies according to the facilities used and the nature of the work, but is in the region of £20 to £35 per hour. Further details may be obtained on request to the Univac Computer Division, *Remington Rand Limited*, 61/65 Holborn Viaduct, E.C.1.

ICT ANNOUNCE 1500 DATA PROCESSING SYSTEM

Issue No. 10 of *ICT Data Processing Journal*, published by International Computers and Tabulators Ltd., 17 Park Lane, London, W.1, and available on application to local offices or subsidiaries of the Company, was received mid-January. It contains several articles of interest to business users of computers, including papers on the following subjects:

(i) Application of ICT 40-column equipment to production planning and control at *Hugh Wood and Co., Ltd.*, the largest British supplier of mining machinery.

(ii) Application of ICT 21-column equipment in the *Nuclear Power Group* administration.

(iii) The installation and use of an ICT 1202 in the offices of the *Groupe des Assurances Alsaciennes* at Strasbourg, France.

(iv) Use of 80-column equipment in Glasgow Corporation Transport Undertaking.

Reports are given in the same issue of the reception of the 1301 Data Processing System, the 1202 General Purpose Computer and the 558 (40-column) Computer at the London and Paris exhibitions in October 1961. (Col. Terrance-Maxwell, deputy chairman of ICT, announced in September 1961 that 61 orders for the 1301 were then in hand, of which more than one-third were for export.)

The introduction of the ICT 1500 data processing system, which is complementary to the 1301 computer, means that this Company can now offer two computing systems—both capable of being expanded in different ways to undertake almost any data processing task in government or business.

Seventeen basically different types of unit constitute the 1500 system, and groupings are planned to meet immediate or anticipated problems since every ICT data processing system is planned to suit the particular needs of the customer. These units can be supplemented on site with additional equipment at any time.

With the 1500 system, extensive training in writing programs in machine codes is not required. In the ICT Rapidwrite system of coding, the scheme is written in simplified English on to partially pre-printed machine cards. These cards are punched and fed through the computer, which prints out full "cobol" and the machine language program, and produces corresponding cards or magnetic tape for subsequent use. This facility, together with a comparatively short delivery period, makes it possible for an installation to be operational as soon as the computer programs and routines are prepared.

Central Processor

Fully transistorised with ferrite core storage, this unit is common to all configurations. The processor can be built with three capacities—for ten, twenty or forty thousand characters—and has a cycle time of 7 microseconds. Word length is variable and the two-address instruction form (each of ten characters) is used.

Input

Punched card (80-column) readers function at 600 cards a minute: one or two readers can be used.

Two types of perforated paper-tape readers are available, one sensing at 100 characters a second and another at 1,000 characters a second.

Output

The card punch can have an output of either 100 or 200 cards a minute. The paper tape is punched at 100 characters a second.

Two alternative line printers can be incorporated in the system. The choice is between a printer giving 1,000 lines a minute with 120 characters to the line, and one printing 715 lines a minute with 160 characters to each line.

A monitor printer is also available for obtaining exception reports or written replies to direct interrogation at ten characters a second.

Magnetic Tape Systems

These systems are made with operating speeds of 10,000, 33,333 and 66,666 characters a second, and provide input and output facilities combined with backing storage.

The 10 kc/s tape units are mounted in groups of six, and two groups can be specified for one system. Tapes of $\frac{1}{2}$ in. $\times$ 1,200 ft are used with recording on six tracks plus parity. Interblock gap is 0·33 in. maximum.

Speed units operating at 33 kc/s are available singly or in combination with the 10 kc/s units. Up to twelve units can be fitted. Tapes of $\frac{3}{4}$ in. $\times$ 2,400 ft. are used with six tracks plus parity, and a timing track—all in duplicate. Interblock gap is 0·55 in. maximum.

Up to twelve tape units at $66\frac{2}{3}$ kc/s can be used, the tape specification being the same as for the intermediate.

Combinations of the three systems can be supplied, and all of them can read in either forward or backward directions.

Backing Stores

Information is stored in two types of file which can be used independently or in conjunction with magnetic tape.

The Data Disc File accommodates 22 million characters on six discs with an average access time of 100 milliseconds. Up to 48 discs (two units) provide additional capacity up to a maximum of 176 million characters. Transfers to and from the central processor are effected at 32,000 characters a second.

The Data Record File has 128 interchangeable records, storing a total of 4,608,000 characters with varying access times which do not exceed 4·25 seconds but may be considerably less. If the maximum of six files is used, 27 million characters can be stored. The transfer rate from the files is 2,500 characters a second.

Magnetic discs and records have facilities that permit direct access to the whole of the filed information, and transactions

may be posted as they occur, irrespective of sequence. Multiple postings of a single transaction to a series of destinations can be made in a single operation. Since both discs and tapes are provided, the 1500 has the advantages of sequential and non-sequential working.

Direct Interrogation

Inquiries concerning information held in the computer can be addressed through a typewriter keyboard, which has direct access to the backing stores. At a rate of 10 characters a second, replies are printed out by the interrogating typewriter.

Simultaneous Mode Control

This device increases the overall "productivity" of the 1500 by permitting the overlapping of any pair of operations involving input and output units, the backing stores and the central processor.

Price

The cost of an installation will vary considerably according to specification, but an effective system including punched card input and output plus a 1,000 line a minute printer would cost about £72,000. A more extensive system, with nominal speed tape units, would cost approximately £105,000.

REGIONAL BRANCH NEWS

BIRMINGHAM

At the first meeting of the 1960–61 session Mr. K. C. Parton dealt with applications of Analogue Computers, a subject which had not previously occurred in the Branch programme. After introducing the principles of Analogue Computation, Mr. Parton described a computer based upon conventional d.c. amplifiers used to investigate the design of control systems, and illustrated its use on problems such as the speed control of d.c. motors, and the voltage regulation of alternators.

In the particular case of electrical power networks, which operate at a constant frequency, a more convenient type of analogue is the Blackburn or transformer analogue, in which a wide range of impedance, and current or voltage generators can be represented by pairs of tapped transformers suitably connected. Mr. Parton described the Witton Network Analyser, a large computer of this type which has electronic amplifiers incorporated to supply the magnetising current of the many transformers, and to feed the measuring circuits. Although at least one accountant in the audience confessed that the finer details of the equipment mystified him a little, the subject of the lecture evoked considerable interest, particularly to those concerned with scientific rather than commercial computation.

A packed meeting on 8 November heard Professor T. Kilburn of Manchester University describe the ATLAS Computer, the latest, largest and fastest computer to emerge from the joint efforts of the University and *Ferranti Ltd.* The machine is designed to handle both scientific and data-processing problems, with many new features intended to assist the programmer and expedite the "house-keeping" operations. In addition to the fast parallel arithmetic circuits, which can handle up to a million commands a second, several programs may be executed in parallel, each with its own set of peripheral equipment, and with simple transfers of data from drum to fast core store. Several thousand words of wired-in subroutines are available in a very fast (0·3 microsecond access time) fixed "read-only" store, and the main store uses magnetic cores, with four separate access systems and a capacity of 16,000 words.

Simultaneous operation of up to eight tape units is provided for, and the ultimate capacity may be increased to 32 tape units, distributed between the eight tape channels.

About two thousand words of the fixed store are allocated to the "controller" program which monitors the state of the peripheral units, and allocates the computing time between the various programs being executed. A novel feature of the controlling program is the "learning" routine which observes the progress of each program, notes which blocks of information are most frequently required, and makes these available in the main store, the less frequently used blocks being retained in the drum store.

This method of operation, while saving the programmer the trouble of writing drum transfer instructions, requires an additional store (the V store) to keep a note of the blocks of information available in the main store, and a very fast set of equivalence circuits which in about $\frac{1}{10}$ microsecond examines each instruction to determine whether it can be obeyed at once from the main store, or requires a drum transfer operation.

Professor Kilburn also described the parallel arithmetic circuits which give a very fast carry-propagation of a few nanoseconds per stage, and approach the limiting operating speed set by the finite velocity of electromagnetic waves along the signal wiring.

GLASGOW

The speaker at the November meeting of the Glasgow Branch was Mr. G. F. Holton, of the *National Cash Register Co. Ltd.*, who spoke on "The Commercial Possibilities of an Elliott 803."

Mr. Holton began by describing briefly the 803 Computer, including in his description both the basic 803 system and additional optional components. The main part of the talk concerned commercial applications, and was illustrated by referring to a well-known firm of publishers. The problems of keeping records of stocks on hand, deciding on the printing of new editions, invoicing, and assessing the demand for various books from area representatives' orders were all considered.

At a meeting on 12 December Mr. Giles gave a description

of the normal type of insured pension scheme demonstrating the volume of calculation required in its maintenance. He pointed out that the small volume of input made it a suitable application for a Computer without magnetic tape. On the ICT 1202 calculation time was well balanced against input/output time and binary punched cards were a convenient form of carrying forward each member's record from one year to the next. The ledger posting facility on this machine made it possible to retain the system of annually updated members' record sheets previously maintained clerically. In reply to a question on the advantages of a magnetic tape machine for this application it was explained that ledger posting and the volume of punched card output were the principal limitations on the speed of the system. Punched cards had the great advantage, from a cost point of view, that they could be handled and listed off line on an existing punched card installation.

On 22 January, 1962, the Branch had as its speaker Mr. L. R. Crawley, of *Standard Telephones and Cables Ltd.* The subject of Mr. Crawley's talk was "Data Transmission."

The available methods of transmitting data were discussed, and the need for ensuring the correctness of the data received introduced the topic of error detecting and error correcting codes. The method involving re-transmission back to the sending station and comparison of the return signal with the original transmitted data was also considered. A comparison was made of the relative costs of the various methods. On the subject of costs, an illustration was given by considering the cost of out-station equipment for an organisation with many regional branches and a single central data processing establishment.

LEEDS

Two Branch meetings have been held since the last report, the attendance on both occasions being over forty members and guests.

On 29 November Mr. A. J. Platt, of *Pilkington Brothers Ltd.*, spoke on the "Problems arising on the introduction of a Computer." He described in some detail the work undertaken by his company prior to their decision to obtain a computer, the work originally done on the computer, and indicated their future plans.

No meeting was held in December, but on 31 January Mr. H. W. Matthews, of *Urwick Diebold Ltd.*, gave a talk on "Data processing and improved Management control by improved Management information," in which he stressed the necessity of providing information on which Management can make decisions (or using the computer itself to make, and in some cases implement, the decisions) rather than providing figures which have no meaning unless considered in conjunction with previous figures.

MIDDLESBROUGH

Since the last report appeared three meetings have been held. On 14 November Mr. F. Taylor, Department of Naval Architecture, King's College, Newcastle, gave a comprehensive survey of the use of Computers in Shipbuilding, with particular reference to fairing of hulls; the procedure was an iterative one and involved the fitting of Chebyshev polynomials to existing data and smoothing the derived polynomials.

On 12 December Mr. J. G. Thomason (*Central Instruments Laboratory, I.C.I.*) spoke on Analogue Computers. He gave a brief description of the "working parts" of a general purpose machine and then outlined the various fields of application.

On 16 January a Symposium on Education for Computing was held. The subject was considered under three headings: (*a*) education by manufacturers, (*b*) education by industry itself, (*c*) education in the Universities and Technical Colleges. Speakers on all three topics were drawn from the Branch membership.

SOUTH WALES

On the 24 January, 1962, Mr. W. F. Ryan, of the General Post Office, gave an interesting and informative address to the Branch at Cardiff on "Data Transmission." He gave a detailed account of the facilities which are available from the Post Office and dealt with the subject both from the aspect of the Post Office and of the user. The record attendance included a number of guests from the Cardiff Post Office.

An active local committee has been formed under the Chairmanship of Mr. H. Mansfield, Deputy City Treasurer, Cardiff, to assist the main conference committee in the arrangements for the Society's 1962 conference which is to be held at the Welsh College of Advanced Technology, Cardiff, from 5 to 8 September, 1962.

SOUTHAMPTON

Since the last report three meetings have been held.

The first was in Bournemouth to serve the considerable number of members who live in that area. This meeting was concerned with the Monte Carlo methods and it was given by Mr. I. C. Pull of the *Atomic Energy Authority*.

Mr. G. Deadman from *Ferranti*, came to talk to the Branch in January and gave a very interesting description of the Gemini Seat Reservation System which his company was installing for the *Trans Canada Air Lines*. The use of punched cards as an input and output medium for the system was particularly interesting.

The February meeting for the Branch was addressed by Dr. S. Vajda who gave a very clear description of elementary processes of linear programming and their use in matrix inversion.

BOOK REVIEWS

Towards Information Retrieval

By R. A. Fairthorne, 1961; 211 pages. (London: *Butterworths*, 40s.)

This is not so much a book as a collection of the works of R. A. Fairthorne. Thus, although these are all on the same theme of document classification and searching, and although they have been ordered to show a rough progression of subject matter, they cannot be regarded as an integrated text. There is a fair amount of haphazard repetition, and many topics get introduced rather obliquely, so that the book is in no sense a clear presentation of the subject for a newcomer.

Its function is rather that of a cocktail cabinet. Although the papers have all been published before and are therefore likely to be familiar to librarians, their collection here provides a handy pool of inspiration in which to dip. It is full of such Fairthornisms as "Direct mechanisation of traditional library classifications is like building locomotives to run with legs," and "mechanisation is much nearer, and probably will be more efficient, than the alternative biological method—selective breeding of clerical staff."

The early chapters deal with information and communication theory and discuss some tried approaches to library problems. They show that the author has a clear grasp of the established principles, and a remarkably wide knowledge of the practice of his subject. Indeed, one hopes that one day he will write a full factual account of his experience in this field, which must surely be valuable; the present book is not this at all, although it contains much useful information.

Later chapters turn to the "conceptual" side of the business, and try to suggest frameworks of theory that may help us to a better understanding of information retrieval. The author has clearly thought deeply and has few if any illusions about the practical effect of modern inventions. In the preface he poses (in provocative words) the key question, "how far can we go in documentation, as in computing, by using ritual in place of understanding?" Later he says, "Those who fear automation as a threat to creative work can be reassured. Remote control in space—telegraph, radio, strings and levers—in no way threatens creative work; far from it. Automation is merely remote control in time." Yet in spite of this, his chapters on theoretical notions (obviously almost entirely his own) seem curiously detached and seemingly pointless. A remarkable chapter on "Algebraic Representation of Storage and Retrieval Languages" displays some very elaborate algebraic formulae and talks about them a great deal, without giving a clue as to what their significance is supposed to be. One is left with the impression that they are a kind of poetic imagery; but even this, in a field in which so much thinking remains to be done, may have its purpose.

The book begins in an unusual way with a couple of "Comments" by other authors. At first sight these look alarmingly like obituaries. One is relieved to find, on reading further, that they are not, and that Mr. Fairthorne is therefore presumably still practising somewhere his own distinctive brand of wit. Long may he do so.

S. Gill

Quality Control in the Office

By P. N. Wallis, 1961; 180 pages. (London: *Office Magazine/Current Affairs Limited*, 30s. 0d.)

One reason advanced by the author for writing this book is that it is a gross extravagance to employ expensive machinery (like a computer) to process data without making sure first that the basic information is thoroughly reliable. Other reasons are that quality can be maintained only if its maintenance is thought of as a separate operation, and the shortage of clerks since 1945 has made detailed checking impossible in many cases.

The book gives an outline of sampling theory and practice (51 pages) and then reviews methods of application to the maintenance of quality of work when dealing with incoming papers, book-keeping, stores records, costing, production control and stock-taking. Chapter 10 (14 pages) deals with electronic computers where "results can be no better than the incoming data" and there follow two chapters on internal and external audit. The conclusions recognise that there is a limited range of jobs, where balancing will give a better control over accuracy than can be obtained by sampling, and the need to increase the tempo of inspection and check if too many errors are found. The appendices give tables of minimum sample size, to detect varying probabilities of error, based on the Poisson distribution, and methods of estimating how much effort is needed for the checking process. The prior requirement for tests of homogeneity by the quality controller or auditor, before relying on any sampling scheme, is emphasised throughout the book.

Office managers, who have not previously studied sampling methods, will obtain useful guidance as to the possible application of sampling to the detection of departures from quality in the work of their sections. The maintenance of quality by suitable training and re-design of procedures can then be directed to where it is most needed. The review copy has been lodged in the BCS Library at Leicester.

H. W. Gearing

Proceedings of the Second Conference of the Computing and Data Processing Society of Canada

June 6, 7, 1960; 365 pages. (Toronto: *University Press* and London: *Oxford University Press*, 40s.)

The 1960 Conference of the Computing and Data Processing Society of Canada was the second national conference of that body. No specific theme was developed during the Conference. Instead papers were presented in general and parallel sessions to emphasise the areas of business data processing and engineering and scientific computing applications. A manufacturers' session was also included in the course of which five selected papers were presented by manufacturers to highlight some concept or technique.

Comparing the present proceedings with the papers read at the previous, 1958, Conference, the overall impression is one of increased confidence and experience, of growing maturity and more general acceptance of EDP. When J. C. Davidson, of the Confederation Life Association, spoke at the 1958 Conference, the CLA were in the process of installing their computer. In his contribution to this collection—*Experience in Implementing a Major Application on an EDP System—*

he compares the plans at that time with the results achieved to date and analyses the experience of two years' work. Among similar papers is one by E. D. Kingsbury of Imperial Oil on *Effective Data Processing in a Large Organisation*, one by L. E. Richardson on the *Electronic Reservation System for Trans-Canada Air Lines*, and one by A. G. Barclay of the Hydro-Electric Power Commission of Ontario entitled *The Achilles' Heel of Data Processing*, in which the need for systems maintenance and programming revision is stressed. Another paper discusses the problems of electrical utilities in forecasting loads at different points of a system and planning new substation capacity or additions to existing substations, while A. A. Titinero contributes an interesting account of computer application to ship design calculations.

Other papers are concerned explicitly with Operational Research. For example, that by B. A. Wilson of the British American Oil Company outlines some of the problems of employing OR techniques that are not functions of the mathematics or logic involved but represent the problems of management in making OR "useful and practical." But, to this reviewer, the most stimulating contribution to the Conference was the keynote address of Arthur Porter of the University of Saskatchewan, *Technometrics and Education*, which, far wider in approach and synthesis, is virtually a condensed introduction to cybernetics. Porter draws attention to, among other things, the contributions to medical statistics and research that could be made by EDP.

The paper by D. B. DeLury of the University of Toronto, *On the Nature of Scientific Evidence* is really concerned with emphasising the serious consequences "indifference to the notion of randomness" may have. He suggests that no conclusion that smoking is the *cause* of anything is permissible from the data considered. Other papers of a more purely scientific character include some elementary remarks on Polynomial Approximations and the more interesting *Compiler for Solving Linear Differential Equations*. R. B. Banerji, of the University of New Brunswick, gives a useful detailed description of a program simulating, it is claimed, the information processing accompanying object recognition. A system of subroutines has been developed enabling list structures to be manipulated while programming an LGP-30 in machine code.

General problems of commercial data processing are discussed by H. S. Gelman in a rather superficial paper on *Programming for Business Systems*, and by J. W. Graham of the University of Waterloo in *Data Sorting with a Digital Computer* in which some of the commonly used sorting techniques are described. This paper links up with that of the IBM representative describing the use of *Random Access Storage Equipment* in the light of experience with RAMAC.

Taken as a whole, the Conference provided much of interest but of uneven quality. It is a pity that the contributed papers did not link more closely, thematically, with the keynote address. That this was not so probably reflects the state of EDP in Canada today as well as the policy of the organisers. As a selective reflection of that state, the present volume certainly fulfils a purpose.

R. GOODMAN

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International Repertory of Computation Laboratories

Issued by the Provincial International Computation Centre, Rome, 1961; $6.50.

This is a complete set, in a loose-leaf binder, of the sheets which have been issued with the Bulletin of the PICC since January 1960. Additions will continue to be issued with the Bulletin, providing a continuous up-dating service.

The entry sheets, one for each laboratory, set out the equipment, personnel, facilities, etc., and are in general very informative in the small space available. The sheets are grouped by country, the countries being arranged in French alphabetical order. Fortunately a list in English order is supplied at the beginning for the help of those who would not think of looking for England (or even Great Britain) under RU. Within countries the order seems to be random, but an alphabetical list of installations is provided at the end. Judging by the English list coverage appears to be fairly good.

This is a very useful reference book. How long it will remain so in this rapidly changing field depends on how efficient the up-dating service proves to be.

J. M. VINCENT

Queues

By D. R. Cox and Walter L. Smith, 1961; 180 pages. (London: *Methuen and Co. Ltd.*, 21s. 0d.)

This new book in the Methuen Monograph series on Applied Probability and Statistics, maintains the normally high standard of this series. This is the first British book assembling together the theoretical material on queues, and the authors have made a splendid and readable survey of the field. Professor Cox has an uncanny facility for writing quite complicated mathematics interspersed with explanatory remarks which carry one along through the most complex arguments in an exhilarating way.

After an introduction, which examines some examples and derives the objectives for the theory, the component parts of the queueing system are discussed under the titles of Arrival Pattern, Service Mechanism and Queue Discipline. The introduction concludes with a few remarks about the applications of Queue theory to real practice which, although perfectly sound, make strange bed-fellows with the Laplace transforms which fill the rest of the book.

The theory starts, as would be expected, with Erlangian theory, with special emphasis on the meaning of statistical equilibrium which plays such an important part in the theory. An interesting extension of a simple queue with random arrival and random exponential service time in which arrival rates and service times are dependent on the queue size is then analysed. From a general case, results for queues with discouragement in servers and limited waiting room are obtained.

The embedded Markov Chain technique is then explained, and the method of deriving the distributions of waiting times and busy period times from the stationary queue distribution is also explained.

Non-equilibrium theory, multi-server queues and priority systems are dealt with in the third chapter.

The adaptation of these techniques to machine interference problems occupies the fourth chapter.

The last chapter deals with the Erlangian technique of multi-stage service to give a more realistic distribution of service time, and this is extended from the original χ^2 distribution to more complex ones. The Lindley integral equation technique for the general queue problem is outlined, and the essential difficulties of the solution of this Weiner–Hopf type equation and how to get round them in particular cases, is yet another of the delightful pieces of mathematical reasoning in this book. The chapter ends with a few pages on simulation and series of queues.

The publisher's "blurb" claims this book will be "of value to operational research workers." The British operational research workers are rather divided on the value of Queue theory, but the reviewer's own opinion that this theory gives valuable insight into the nature of queueing, and that its application to a particular problem gives insight to that particular problem, is gaining favour.

This book is valuable to operational research workers in so far as it gives them insight into the theory of queues.

K. D. Tocher

An Approach to Cybernetics

By Gordon Pask, 1961; 128 pages. (London: *Hutchinson and Co.*, 12s. 6d.)

Norbert Wiener, who first gave the word Cybernetics its most usual modern meaning, defined it as the "Science of Control and Communication in the Animal and Machine." This broad definition includes Communication Theory and Automatic Control—and much besides.

When Gordon Pask writes about Cybernetics he does so as a master and noted originator. His *An Approach to Cybernetics* aims to put the uninitiated right in the picture. It covers an enormous field in 113 pages.

In the first chapter Mr. Pask expands and adds to Dr. Wiener's definition, and in the second goes on to "learning." The term "learning" is a difficult one, meaning quite different things to different people. Mr. Pask uses it to mean the process whereby an observer of a system becomes less and less uncertain about the system. He therefore writes about uncertainty, sometimes profoundly and subtly, at some length. Mr. Pask has described his more complex ideas very lucidly, but has often added complexity to simple ones.

The chapter on learning is followed by ones on "The State determined behaviour" and "Control Systems." Mr. Pask considers simple systems of which every state can be predicted with certainty knowing the state from which it came, more complex ones which can be looked upon as simple ones coupled together in some way, and systems in which every state can be predicted with a known probability of success. He says a little about most of the well-known control systems, and rather more about some which are not so well known, including some of his own. His chapter on biological controllers covers such matters as control systems in living things, as the recognition of shapes and forms, the behaviour of devices like Dr. Grey Walter's "Tortoise" and the general phenomenon of "problem solving." In a chapter on teaching machines Mr. Pask describes, amongst others, some of his own very interesting machines—including, for example, one designed to train people to use a typewriter, and in a chapter called the "Evolution and Reproduction" of Machines he includes some of his own work on the development of metallic threads in tanks in which current flows between electrodes immersed in acidic solutions of metallic salts. Mr. Pask ends his book with views on the present workings of industrial organisations, and their future.

An Approach to Cybernetics contains many of its author's own often profound and stimulating ideas. It is very easy for people to be confused when they find new ideas named by existing or concocted words which have or imply unwanted associations. Mr. Pask avoids this trap by naming his concepts by letters. However, he has taken this idea much too far. He describes many simple ideas in mathematical-like notation even though they are much better expressed in non-mathematical terms. In this way he creates quite unnecessary difficulties for the average reader. The book contains no mathematical proofs or purely mathematical arguments, but it does contain a great many mathematical symbols and equation-like statements which are in fact not used.

It is by no means an easy book to read and understand. Frequently hard work spent on understanding a passage uncovers only a trivial statement confused by not really relevant strings of mathematical symbols; but even so it is worth a considerable effort in reading. At times it will disappoint, often it will annoy—but it will leave the reader with a much greater understanding of the subject.

E. A. Newman

Design Fundamentals of Analogue Computer Components

By R. M. Howe, 1961; 268 pages. (London: *D. Van Nostrand Company, Ltd.*, 56s. 6d.)

The Author's Preface states: "This book has evolved from a set of notes written by the author to accompany a course on analogue computer components given in 1958 for the Research Laboratories of the General Motors Corporation," and in the result we have something very much in the style of an engineering college text book. It is a well-written and well-presented text book which treats the subject in about the right breadth and the right detail for the student. It is rather less "fundamental" than its title might convey, and it does not include mechanical analogues nor the incremental type of analogue computer, although the latter receives mention in passing. It omits all special purpose design and concentrates, as a text book should, on the standard machines and the standard tricks of design (d.c. only; even a.c. systems are not mentioned). These are brought to reality by excellent descriptions of some of the better-known American components—Amplifiers, Multipliers, Recorders, etc. Sources of error are clearly and concisely presented.

One of the best chapters in this book is the first, which discusses "system considerations." Such matters are included as patchboards, time calibration sources, overload indication, and problem check circuits both static and dynamic. The principles, the realisable accuracy, and user requirements are clearly interwoven in 19 readable pages with many thumbnail descriptions of features of commercial products.

There are nowadays several books which treat this subject competently, but none more so than this one. It should be added that this is as much a book to educate the user who wishes to get the last ounce of performance from his computer, as it is for the student of d.c. electronic analogue computing machinery.

K. H. Treweek

Current Bibliography on Computers

Weisbaden, Germany: *Franz Steiner Verlag Gmbh.* Quarterly. (96DM per annum, 76.80DM for regular orders from University institutes.)

This bibliography, *Titel von Veröffentlichungen über Analog- und Ziffern-rechner under ihre Anwendungen,* has appeared regularly in German since 1954, edited by the Documentation Centre of the Computer Commission of the Deutsche Forschungsgemeinschaft (DFG). Since the beginning of 1961 the International Computation Centre (Rome) has joined the DFG in editing the publication and an English translation is given of the German text.

The publication does not contain abstracts or reviews; it does, however, contain key-words on the contents of the papers including, most usefully in the case of applications, the name of the particular computer referred to in the article. An alphabetical index in German and English of these key-words is published for the four issues of every volume.

The field covered is about 150 periodicals. A list of these is not available to this reviewer but they appear to include all the English language ones normally found in a computer department library as well as rather more German ones than are usually available. Conference reports are also well covered, which is important in this field. Books are included, and some industrial publications, and there is a list of German patents pending.

The absence of reviews or informative abstracts reduces the delay in the appearance of the references and also, very substantially, the cost of the publication. (£6 18s. 0d. per annum for a university institute.)

As a title list, with the keywords as an additional guide, this seems a useful reference work especially for a small library which does not take all the Abstract and Review journals.

J. M. Vincent

An Algorithm for Translating Chemical Names to Molecular Formulae

By Eugene Garfield, 1961; pp. ix + 68. (Pennsylvania: *Institute for Scientific Information.*)

The book describes recent work on the mechanical conversion of the systematic name of an organic compound into its molecular formula, i.e. the numbers of atoms of different chemical type that are present.

Chemists give names to compounds for three quite distinct reasons:

(1) To identify the compounds in their own work; such names are often little more than a serial number, possibly tacked on to the name of the individual concerned, and give no real information about the compound.

(2) To describe the compound; this is the "Systematic Name," formulated using rules which have been devised at several international conventions, which gives enough information to describe the structure of the compound completely.

(3) To index the compound; one method of doing this is to name the compound by its molecular formula.

The process of conversion from a name of the second type to one of the third type is shown to be formally equivalent to a translation from one rigorously defined language to another. The linguistic variables used in constructing the systematic names are described and classified into three groups; locants, which indicate the position in the molecule to which reference is made; parens, which serve to remove ambiguities; morphemes, which either identify a simple group of atoms, or show how many of a given group, not necessarily a simple one, are present.

It is shown that, since the molecular formula takes no account of position within the molecule, all locants may be ignored. What remains is essentially an algebraic expression containing brackets, whose evaluation is relatively simple, apart from the not inconsiderable difficulties involved in recognising and classifying the morphemes.

It is difficult to be sure of the audience which this book aims to reach. To the mathematician, with little background knowledge of the chemical problems involved, the book will possibly appear to be a rather limited exercise. To the chemist, the jargon of language translation may prove to be a major stumbling block in mastering what is, in fact, a simple and highly effective method of calculating molecular formulae. Anyone who has ever tried to retrieve chemical data from the ever-growing amount of published material will welcome this new approach and be interested in its further development.

Very few misprints were found; three of the flow-diagrams seem to contain trivial errors, which makes for some confusion.

M. Wells

Programming and Coding for Automatic Digital Computers

By George W. Evans II and Clay L. Perry, 1961; 249 pages. (London: *McGraw-Hill Publishing Company Ltd.,* 74s. 0d.)

It is difficult to find material in this book which is not adequately dealt with elsewhere, nor is the selection particularly to be commended. As an "organised approach to basic programming and coding" offering to promote the writing of efficient programs and automatic coding procedures it will undoubtedly succeed to some extent, but in the secondary purpose of assisting in the diagnosis of faulty computer operation a highly dangerous weapon is placed in the hands of the new programmer. Nevertheless, the first half of the book deals quite soundly with the important basic ideas of machine schematics, number representation, scaling, flow charting, subroutines, loading routines, and optimum coding, with particular reference to the problems presented by small machines. Two imaginary decimal machines are constructed for purposes of illustration, one of two-address and the other of three-address type. The grafting of B-boxes on to the order code of the latter machine has unfortunate consequences in the resultant codes, and makes a far from elegant introduction to the common coding techniques employed with these registers.

The second half of the book has chapters on magnetic tape programming, automatic programming, the "algebra of statements," numerical analysis, and the organisation of a computer installation (including some remarks on debugging which could well have been expanded). As may be guessed, little more than acquaintance with each of these topics is provided.

There are two instances of subject-matter which come as a timely reminder of the dangers of introducing elementary programming as a formal undergraduate course. The first (in Chapter 2) is a laborious treatment of the elementary arithmetic operations as applied to numbers represented on an arbitrary radix. To the programmer, who can comprehend the number system of any particular machine in an hour or so, this is surely unnecessary; to the undergraduate it represents time taken from more rewarding studies. The second instance appears in Chapter 9 in which a minimal introduction to Boolean algebra is followed by an artificial application to a payroll calculation. It seems, on the whole, misleading to infer that such developments in algebra or logic are important to the understanding of computer programming at this level. To be sure, it is disconcerting to teach a subject which, without reference to a particular machine or a particular problem, tends to evaporate; nevertheless the most successful treatments, and the most successful parts of this book, are the ones which keep to the essential mechanics of the subject.

J. K. Iliffe

Automatic Data Processing

By Derek Wragge Morley, 1961; 76 pages. (London: *Her Majesty's Stationery Office*, 6s.)

This booklet comes from the Information Division of the Department of Scientific and Industrial Research. To quote from it: "*Automatic Data Processing* deals with one of the most serious problems created by the growth of industry and the expanding interests of commercial concerns—the need to process rapidly and efficiently immense and ever-increasing quantities of data." The contents of the booklet are neatly set out and, from the subject headings listed, the booklet appears to cover the areas between "The Problem," "The Need," through descriptions of how a computer and its associated equipment work, the development of ADP in the UK to examples of data processing. This takes approximately 50 pages. Two pages are devoted to the future and the remaining pages to brief details of computers currently available in the UK and Computer Service Bureaux.

With so little space and so much to say one would expect to find the booklet written in a crisp, accurate style. Mr. Wragge Morley, although an accomplished journalist, has not written in a simple, easy to follow manner. The *Daily Mirror* style of short simple sentence would have served him better than the style of *The Financial Times*.

The booklet is not completely accurate. A three-page account of a magnetic film storage application does not contain the sequel—that the job is no longer run on a computer but on 40-column punched card equipment! It is not easy to see exactly when the booklet was written—sometimes it seems like 1958, at other times 1961. At least one remark suggests the summer of 1961. Whenever it was, one of the original British firms making computers and which has been operating a computer service in London since 1956, is not included in the list of Computer Service Bureaux. The independent consultants, of which there are several who sell computer time, are also not mentioned.

The performances quoted about hardware are not always as up to date as they should be. The punched card reading speed of a modern computer system is quoted between 200 and 400 cards per minute. There is no mention of the ICT 600 l.p.m. printer, although the Rank Xeronic is mentioned. Aural reading is discussed as are document reading systems, but there is no mention of data transmission. The examples chosen to illustrate ADP do not contain an application in Production Control and the ICT Letchworth experiment might have been mentioned. Admittedly this has been well written up many times but so have most of the examples mentioned.

It is a pity that this booklet, coming as it does from the DSIR and published by HMSO, is not more up to date and forward looking.

In conclusion, the ideas behind a document of this nature are sound but, in practice, I cannot recommend a reader of *The Computer Bulletin* to buy it.

P. G. Barnes

Management Games

By J. M. Kibbee, C. J. Craft and B. Nanus, 1961; 347 pages. (London: *Chapman and Hall Ltd.*, 80s. 0d.)

This book is a readable and informative survey of the field of management games. It is divided into five sections dealing respectively with general background, game administration, game design, case studies and a survey of existing games.

Part I constitutes an effective introduction to management gaming. There is a slight initial tendency to "oversell" management gaming. The balance is, however, redressed by an adequate discussion of the limitations of gaming. One or two relatively innocuous paragraphs in this section tend to "oversell" Remington Rand Univac games as compared with other management games.

Part II is a useful and practical discussion of game administration and the difficulties that may be encountered by the organiser of a game. Anyone organising a game for the first time would do well to read this section.

Part III gives a lucid, non-technical discussion of mathematical and computer aspects of game design. Fundamental aspects of game design, such as the role of parameters in increasing the flexibility of the model, are clearly brought out without making heavy demands on the technical competence of the reader. The remarks on computer programming of games are to the point, although the professional programmer will find them all too brief. The short section on management-game compilers points in the right direction, again without giving any substantive details.

Part IV includes six case studies with appendices containing complete specifications of a number of management games. This section, together with Part II, contains sufficient information for a game organiser to organise any one of the games described.

Part V contains a fairly exhaustive list of references to existing management games, each with a short description and an address from which further information may be obtained. A useful bibliography is also included in this section.

The book constitutes a well-balanced and comprehensive account of management gaming. Although the authors feel strongly that games have a very important role to play in a wide variety of training programmes, they present the reservations of non-enthusiasts with remarkable fairness and clarity. The book successfully combines the function of a readable introduction to the subject, with that of a reference manual for the specialist. The present reviewer feels that the standard

of readability of this book is to be highly commended, and hopes that the book may serve as a model to other authors concerned with writing non-technical surveys in this age of specialisation.

PETER WEGNER

Stand des elektronischen Rechens und der elektronischen Datenverarbeitung in Deutschland

By K. Prause, W. Möhlen and W. Fleiss, 1961; 173 pages. (*The Deutschen Arbeitsgemeinschaft für Rechenanlagen* (DARA).)

This review of electronic computers and electronic data processing in Germany was made by the German Computer Society (Deutschen Arbeitsgemeinschaft für Rechenanlagen) as a result of the International Conference on Information Processing held in Paris in 1959. The gathering and preparation of the information for this review has taken rather longer than was originally expected. However, the result seems to have been worth the delay, as this booklet gives a detailed picture of the state of computer technology in Germany at the middle of 1960.

The review starts with a short account of the development of computers in German universities and industry. This is followed by a series of tables giving, where possible, the uses of computers, both digital and analogue. This shows that there are more than 200 digital and about 30 analogue computers installed and working in Germany. Of these, about half are of German design and manufacture.

The bulk of the review is concerned with a description, with considerable technical detail, of all the digital and analogue computers built in Germany up to the middle of 1960. Some of these machines are of very early design, developed by universities and technical colleges, and are of mainly historical interest. However, they serve to fill in the background to this very competent review.

The booklet is very well presented and is profusely illustrated.

M. MARCOTTY

NEWS FROM MANUFACTURERS

RAF Supply Control

A new system of supply control, employing the latest developments in automatic record-keeping, is now being set up by the Air Ministry. It will enable a supply control centre in Britain to maintain an hour-by-hour picture of the supply situation throughout the Royal Air Force.

An order has been placed with the *National Cash Register Company* for a large number of accounting machines coupled to automatic punched paper tape recorders. This equipment is to be installed at Royal Air Force stations and maintenance units all over the world. It will be used to maintain normal printed records of receipts and issues for local use, and simultaneously to punch information into paper tape for transmission to the supply control centre. The printed records and tape will be produced at the same time that supply action is taken, and in both cases the information will be checked automatically by the machines.

The information punched into tape will be transmitted over the Royal Air Force's established network of teleprinter lines. When it reaches the Centre, it will be fed into the EMIDEC 2400 electronic computer ordered by the Air Ministry several months ago. The computer will up-date the individual records stored in its "memory" and print summaries for control purposes. About three-quarters of a million different items of equipment will be controlled in this way.

Because of the speed and accuracy of the world-wide reporting system, the Air Ministry will be able to break away from conventional methods of supply control. No longer will individual stations be responsible for reordering equipment as issues are made—all replacements will be dealt with automatically by the Supply Control Centre. This centralised control system will enable the Royal Air Force to develop still further its ability to make vital equipment available at the right time and place.

The accounting machines which produce local records will be of the type widely used by banks and business firms. Because of their many automatic features, specially-trained operators will not be needed.

The new system will be the first in the world to make such wide use of the recently-developed technique of "capturing" accounting machine information on tape for transmission to a central computer. All of the accounting machines and paper tape recorders will be manufactured at the Dundee factories of the National Cash Register Company.

Second EMIDEC Computer for Barclays

Satisfied with the EMIDEC 1100 computer installed at Barclays Bank No. 1 Computer Centre in Drummond Street, London, last summer, Barclays Bank has now ordered another similar computing system from *EMI Electronics Ltd.*

The Centre was designed to accommodate two computers and the second EMIDEC will be sited in an adjacent room to that housing the first computer. It will be employed on similar work to the first EMIDEC—handling centralised bookkeeping of current accounts for a further group of the Bank's London branches.

An EMI-Anelex line printer will give a print-out speed of up to 1,000 lines per minute—the fastest output being obtained from any printer currently in operation. Barclays' second EMIDEC 1100 computer is scheduled to be delivered in the latter part of 1962.

Modular Cheque-Sorting System

Ferranti-Packard Electric Ltd. of Toronto, an associated company of *Ferranti Ltd.*, Hollinwood, Lancs., announce a modular cheque-sorting system.

The modular concept of cheque-sorting systems has been designed around the use of building blocks, each being a plug-in unit with specific capabilities. The system in its simplest form comprises a central dictionary look-up reference module, drum-load and print-out facilities, simulators, controls, and power supplies.

To the central unit, separate input/output channels can be plugged in, each individually comprising a magnetic ink character reader, a cheque sorter (12 or 18 pocket), a line printer (and/or optionally one or more multiple pocket printers), read-in logic, input/output buffers, and arithmetic units. To each channel, as an optional extra, magnetic tape units can be added should the retrieval data be required for further processing.

Any or all of these features can be added on the building block principle, and as increasing volumes warrant, the system can be expanded to accommodate up to three 18-pocket sorters to provide a combined sorting rate of up to 290,000 cheques per hour.

In the event that only digital sorting is required, the dictionary look-up section of the central computer can be eliminated. Alternatively, combination dictionary look-up and digital sorting facilities can be provided.

The electronic circuits use modern transistor techniques to ensure high reliability, low maintenance and low power consumption and heat generation.

This system operates on 115 volts, 60 cycle, 15 amp, with separate power connections being required for each cheque sorter. Normal office environmental conditions are acceptable.

Dataplotter

A new high-speed, high-accuracy magnetic tape X–Y DATAPLOTTER that automatically and economically reduces digital data to graphic form for easy interpretation and study has been announced by *Electronic Associates, Ltd.*, Burgess Hill. The Series 3440 magnetic tape DATAPLOTTER offers complete facility for off-line plotting of digital information as ink plots on 30 × 30 inch or smaller graph sheets. Digital data may be read directly from magnetic tape, punched cards or punched paper tape. Point plotting, line plotting and symbol printing may be done with equal facility.

The outstanding features of the 3440 are: completely solid state for greater reliability; no temperature controlled environment necessary; automatic set-up from commands written on magnetic tape; plotting speeds up to 4,500 line-segments per minute; all data selection performed by dials; automatic data selection and location; overall plotting accuracy very close to the width of the line drawn, and plots up to four decimal digit numbers of either sign.

The Series 3440 DATAPLOTTER may be used in every area of business and science for plotting design calculations, business trends, production fluctuation, statistical graphs, data processing, weather charts, contour maps, actuarial graphs, missile trajectories and space vehicle orbits.

Mass Production Sealing of Transistors

Scientists working in *IBM Components Division* in Poughkeepsie, New York, have developed a new mass-production method of sealing micro miniature diode and transistor elements against moisture and contamination from the atmosphere. These units are fabricated on a silicon wafer containing a thousand transistors in the area of a thumbnail and are then coated with silicon oxide. A special glass powder is applied to the oxidised surface and the wafer is fired at more than 1500° Fahrenheit. The result is a protective film of smooth, chemically resistance glass only 1/10,000th of an inch thick.

Following the sealing process the wafer is cut by an ultrasonic "knife" into its separate units. Each retains its permanent glass seal to protect the critically sensitive surface, electrical contact being made through microscopic holes etched through the glass and oxide.

Spillers to Use Computer

Spillers Limited are to install an electronic computer at their new head office in Cannon Street, London, E.C.4. This will enable them to centralise much of their paperwork—now done at five area offices—and also to reduce their operating expenses.

The computer will automatically price orders, compile and print invoices, keep sales ledger records for very many thousands of customers, and produce sales analyses and other reports for the guidance of the management. The system will cover most of Spillers' varied interests, including flour, animal feeding-stuffs, pet foods and grocery products, and has been designed to enable area offices to maintain existing relationships with customers. At present the different stages of sales accounting are carried out at area offices, using up-to-date office machinery; by integrating them at one central point Spillers will reduce to a minimum the amount of recording necessary for efficient operation.

The machine chosen for this purpose is the new N.C.R. 315, developed by the *National Cash Register Company*. A key feature of the installation will be CRAM, N.C.R.'s unique "memory" which enables transactions to be processed at very high speeds in either random order or in sequence. Spillers' selection of the 315 was influenced very largely by the flexibility of this new technique of storing and up-dating information, which offers many advantages over the older magnetic tape system.

In the Spillers' installation, over 22 million characters will be instantly available for processing at any one moment. The compact CRAM cartridges will be used to hold a complete history of every customer's account, and to accumulate up-to-the-minute sales statistics. To facilitate the pricing of individual orders, CRAM will also memorise details of all sales contracts entered into with customers, as well as recent and current price lists.

Details of deliveries made will be fed to the computer in the form of punched paper tape. Invoices—amounting to several thousands per day—and other documents will be produced at speeds of up to 680 lines per minute by an automatic printer directly coupled to the central processor.

Computer Control of 3,000 Year Old Industry

The world's first application of computer control to the 3,000 year old paper manufacturing industry was announced early in November, when Potlatch Forests Incorporated of Lewiston, Idaho, demonstrated their newly installed IBM 1710 Process Control System.

The system includes the new 1711 Data Converter which translates instrument readings into computer language, and

the small, powerful IBM 1620 computer. The 1710 system is able to record, store, analyse and report data from 46 separate points, soon to be extended to 200, within the 200 yard long paper-making machine at the Clearwater plant of P.F.I. Reports are produced in visual form to technicians and factory operatives, who are thereby able to exercise closer and more immediate control of quality and production than has previously been possible. The 1710 system reports to the operator via high-speed typing, pin pointing trouble spots by typing in red. The operator evaluates the information in the light of experience and can then make the necessary changes. The main objectives of process control by this means are:

1. Prediction of quality-test results during manufacture.
2. Control of moisture content to reduce breakage.
3. Reduction in quantity and duration of off-grade production.
4. Recording of all instrument data relevant to operating success or failure, as a guide to future operating.
5. Continuous monitoring of the operation of the pulp mill, caustic plant, bleach plant, coating system, drying and refining process.

At present, the system is reading information into the computer which converts it into operator reports. At a later stage the computer will generate signals automatically from this information, to control points on the paper-making machine instantaneously and without operator intervention.

Air Ministry saves £25,000 a year

Sir Maurice Dean, K.C.B., K.C.M.G., Permanent Under-Secretary of State for Air, pressed a button at the Central Civilian Pay and Records Office, Cheadle Hulme, Cheshire, on Tuesday 16 January, setting in motion an EMIDEC 1100 computer which in the course of the next 18 months will progressively take over the pay accounting and records of the Air Ministry's 70,000 civilian employees in the United Kingdom.

At present civilian pay accounts are maintained at various regional centres at individual Royal Air Force units and Air Ministry Headquarters. The pay accounts will gradually be passed to the computer centre and, by the end of the summer of 1963, all will be maintained at Cheadle Hulme.

The planning staff for the system was set up in London in 1957 and an order was placed for the computer, an EMIDEC 1100, designed and built by *EMI Electronics Ltd.*, in June 1959. The nucleus staff of the CCPRO moved to Cheadle Hulme in August 1960 to prepare programs and systems and the computer was delivered in April 1961. Since then many programs for the computer have been completed and tested and the clerical staff recruited and trained. The capital cost of the whole system is estimated at £328,000 which, spread over the next 10 years, is expected to show a saving of about £25,000 a year in addition to increased efficiency arising from specialisation. The centre at present has about 130 employees and the eventual total will be about 180. By the time it is fully operational, just over 300 employees at the existing pay offices throughout the country will be released for employment elsewhere within the Air Ministry organisation.

The computer system is not merely designed to produce a payroll. It is able to interpret the effect on individuals of complicated staff regulations covering some hundreds of different grades. The system contains a number of unique features in the field of personnel management. For example, sick leave entitlement, a complicated subject which has hitherto required considerable attention from specialised management staff, will be controlled automatically.

The computer uses magnetic tape for storing historical data which can be held outside the computer available for use as and when required. One application of this feature is to maintain master records of service for all Air Ministry employees for use by central and local management. These records will also enable the computer to calculate superannuation benefits. The Air Ministry will have at its disposal in one central office a system which not only is capable of dealing with all aspects of pay, but will also be increasingly developed as a tool of personnel management.

New Oscilloscope

To meet the special requirements of the Computer industry, involving investigations into constant time storage systems and examination of waveforms associated with magnetic-drum storage and loop tape storage systems (requiring oscilloscope strobing facilities), *Telequipment Limited* have introduced oscilloscope type D.55.

Type D.55 costs £250 and is available throughout the Home and all export markets. The model was in fact originally developed in order to observe complicated digital pulse trains during the "systems testing" of the electronic cubicles incorporated in the STRAD high speed automatic electronic message switching equipment which, automatically accepting, sorting and retransmitting messages to their appropriate addresses at a speed of 83,000 words per minute, is manufactured by *Standard Telephones and Cables Limited.*

The D.55 is a double beam instrument, and has two time bases, "A" and "B." "A" is a conventional wide range time base, "B" is a slow speed time base for use as the delaying sweep. The instrument has a unique facility whereby a signal displayed on the lower beam has a brightup marker superimposed on it; this marker may be moved over the entire length of the trace by the delaying sweep control; the portion of the signal covered by the marker is determined by the setting of the main sweep and is simultaneously displayed across the entire length of the upper trace.

This facility is particularly useful for identifying and expanding portions of a complex waveform, and is particularly suitable for many computer applications. In addition, the instrument is particularly suitable for use as a general purpose oscilloscope where a large display is required.

The D.55 uses a Double Gun 5″ spiral PDA tube giving a bright, finely focussed trace, and has independent brightness and focus controls. The two identical *Y* amplifiers have a band width of DC – 6M/cs (– 3dB) at a maximum sensitivity of 100 mV/cm.

THE BRITISH COMPUTER SOCIETY PUNCHED-CARD SURVEY

(See p. 145)

QUESTION

1. Description and Address of Installation

2. Please place tick against the one application selected for the purpose of this survey. If details applicable to more applications are available please use one form for each. If details supplied are for an application not listed, please describe it briefly.

APPLICATION		
1	General Accounting and Statistics	
2	Costing	
3	Payroll	
4	Sales Statistics	
5	Sales Accounting	
6	Stores Accounting	
7	Production Control	
8	Pension Records	
9	Scientific Statistics	
10	Plant Component Records	
11	Personnel Records	
12	Purchasing Analysis	
(other applications)		

3. Please place tick against make and type of keypunches used and delete inappropriate keyboard.

MAKE		
1	Bull	
2	Hollerith Type	
3	I.B.M.	
4	Powers Type	
5 (other equipment)		
1	Automatic	
2	Hand Operated	
1	12 Key Numeric Keyboard	
2	Typewriter Keyboard	

4. Please state card columnar capacity.

5. Please state number of punch and verifier operators employed.

Punching	
Verifying	

6. Please state number of punch and verifier operators falling in each age group.

AGE GROUP	PUNCHING	VERIFYING
Under 20		
20 to 29		
30 to 39		
Over 39		

7. Please state average experience of punchroom staff in months.

STAFF	MONTHS
Punching	
Verifying	

8. If key verifiers are not used, please state method of verification.

9. Please place tick against person with responsibility of decision on doubtful data.

1	Supervisor	
2	Verifier Operator	
3	Other	

10. Please tick, as appropriate against type of document which contains punching information relevant to this survey.

1	Designed specifically as punching document	
2	Designed principally for another purpose, but with punching in mind	
3	Designed entirely for another purpose	

11. Please tick as appropriate the method of preparing the punchin g document.

1	Pencil Manuscript	
2	Ink Manuscript	
3	Typescript	
4	Other: Please Describe	

12. Please indicate number of columns gang punched and key-punched in each card.

Gang Punched	
Keyed Numeric	
Keyed Alphanumeric	

13. Please state *average* number of key depressions per minute for punch and verifier operators separately.

Punch (all jobs)	
Punch (survey job)	
Verifier (all jobs)	
Verifier (survey job)	

14. Please state number of error cards per 1,000 found by verification process.

Error cards per 1,000 (all jobs)	
Error cards per 1,000 (survey job)	

15. Please indicate percentage of errors by type. Please describe errors NOT listed.

1	Wrong Column	
2	Double Punching	
3	Wrong Key	
4	Other	
	Please describe other errors	

16. Please state number of error cards per 1,000 found *AFTER* verification processes.

Error cards per 1,000 (all jobs)	
Error cards per 1,000 (survey job)	

17. Please indicate how residual errors are detected.

1	Balance Totals	
2	Split Tabulator Controls	
3	Credibility Checks	
4	Visual	
5	No Special Routine for Detection	
6	Other: Please Describe	

18. Name of Person making return ....

Date ....

Completed Questionnaires should be forwarded to

The British Computer Society, (Ref. HWG),
Finsbury Court,
Finsbury Pavement,
London, E.C.2.

Individual replies will be treated confidentially.